OVERSIGHT HEARING ON THE OFFICE OF TECHNOLOGY ASSESSMENT

HEARING

BEFORE THE

COMMITTEE ON RULES AND ADMINISTRATION UNITED STATES SENATE

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OVERSIGHT HEARING ON THE OFFICE OF TECHNOLOGY ASSESSMENT

FEBRUARY 5, 1982

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OVERSIGHT HEARING ON THE OFFICE OF TECHNOLOGY ASSESSMENT

FRIDAY, FEBRUARY 5, 1982

U.S. SENATE,
COMMITTEE ON RULES AND ADMINISTRATION,
Washington, D.C.

The committee met, pursuant to notice, in room 301 of the Russell Senate Office Building, at 10:06 a.m., the Honorable Charles McC. Mathias, Jr. (chairman) presiding.

Present: Senators Mathias, Warner, and Cannon.

Staff present: Joseph E. diGenova, staff director and chief counsel; John B. Childers, deputy staff director; William M. Cochrane, minority staff director; John K. Swearingen, director, technical services; Ann B. Cook, chief clerk; Peggy Parrish, professional staff member [minority].

OPENING STATEMENT OF HON. CHARLES McC. MATHIAS, JR., CHAIRMAN, COMMITTEE ON RULES AND ADMINISTRATION

The CHAIRMAN. The committee will come to order. Ten years ago, the Congress established the Office of Technology Assessment to provide the Members of the Senate and House of Representatives with what was described as "unbiased information concerning the physical, biological, economic, social, and political effects" of technology. OTA was to provide an early appraisal of the probable impacts, positive and negative, of technology, and to develop information to assist the Congress in meeting the challenge of a technological society.

I have often wondered myself what we might have done differently had anyone anticipated what the invention of the tin can or the invention of the pneumatic tire was going to do to change the way of life of the human race. Those are perhaps homely examples of the kind of thing we were reaching for.

The creation of OTA was to provide for the Congress a tool to address more effectively than it had the conflicting goals, values, priorities, resource allocations, and the distribution of benefits associated with technology. OTA's work was designed to allow the Congress to make more informed judgments and provide a resource accountable only to Congress.

Today, the committee will take a look at this organization to see how, 10 years later, it is fulfilling its mandate. We will examine, among other topics, the timeliness of OTA reports; on how key national issues have been reflected in OTA's assessments; whether or not OTA has the resources to fulfill its obligations; and the relationship of OTA's work to the improved formulation of public policy or legislation.

Congress needs strong support in the area of technology assessment because the significance of scientific achievements is not always immediately apparent. In 1975, my friend and neighbor George Will wrote in one of his columns on the most consequential event of that year. In it he noted that while the biggest news of 1932 was the election of Franklin Delano Roosevelt, that in that same year James Chadwick of Cambridge University discovered that the neutron was the key to atomic fission. That discovery didn't seem to significant in 1932, but seen in retrospect it had a profound effect on the course of the world.

George Will went on to point out that the big news of 1953 was the armistice in Korea and the inauguration of Dwight David Eisenhower. However, 1953 was also the year that Watson and Crick published a paper that began "We wish to suggest a structure for the salt of DNA." Today, we are still reeling under the impact of that discovery.

In 1975 the big news was the fall of Saigon, the near fall of New York, and the CIA and FBI at the same time. Meanwhile, a team of scientists at Harvard constructed a mammalian gene.

Now, weighing the historic importance of these political events against contemporary scientific events, I think it is very difficult not to agree with George Will that in the long run the impact of the scientific events dwarf to insignificance the political events which, at the time, dominated the news. And there is, I think, an object lesson here, and it is an explanation as to why the Congress needs technology assessment.

As a member of OTA's Technology Assessment Board, I am aware of its successes and also of its problems. But I think it is important that OTA's performance be examined and explained to those Members who may not be sufficiently aware of its work. And I think most importantly the committee wants to utilize this hearing to explore how OTA can better serve the needs of the Members of Congress.

We are honored and privileged to have as our first witnesses today the Chairman and Vice Chairman of the Technology Assessment Board, the distinguished Senator from Alaska, Mr. Stevens, and the distinguished Representative from Arizona, Mr. Udall.

TESTIMONY OF HON. TED STEVENS, SENATOR FROM THE STATE OF ALASKA, AND HON. MORRIS K. UDALL, REPRESENTATIVE FROM THE STATE OF ARIZONA

Mr. UDALL. Thank you, Mr. Chairman.

Senator STEVENS. Mr. Chairman, I am going to yield to our colleague from the House, he has another engagement and I do not.

Mr. UDALL. This is the first time that Senator Stevens has not had a previous engagement himself so that he could go first. You are being very kind and generous to me here.

I have a prepared statement, and I would like to have it inserted, and let me give you a couple of thoughts, and I would be glad to respond to any questions.

The **Chairman**. Without objection, your statement will be admitted into the record as if read.

Mr. **Udall**. One of the key decisions that was made when we established OTA was to keep it bipartisan, to have an equal number of Senators and House Members, and an equal number in each body from the two political parties. And thus it is, with the surprising strength that the Grand Old Party showed in 1980, that Ted Stevens turned out to be chairman instead of having another position in it. I had just finished a term as chairman, as the senior guy on the House side. So it turned around; it was formerly a Udall-Stevens administration, and these 2 years it's Stevens-Udall. I think we have done fairly well, in all modesty and humility, if I may say so.

The OTA idea took awhile to catch on here. I started a bank once out in Arizona when that was a remunerative thing to do, and I was amazed—we had 4 years of utter confusion and we went through three presidents and two chairmen of the board; it was kind of a shakedown cruise we had to go on somehow to get an institution functioning, settle various problems and apprehensions about it. We had the same thing in OTA. It was an uncertain time; calls were heard for abolition of the OTA because it didn't work and it was a waste of time and money.

We have now finally come of age. And I don't know very many people who quarrel with the record that OTA made in the last Congress, in which Senator Stevens and I were chairman and vice chairman, respectively. We have had all kinds of senior committee chairmen who feared that this was somehow an encroachment on their prerogatives, who now see that OTA can be a very positive help to them as they approach these legislative matters.

I have listed in my statement some of the things that we worked on and that have proven out. The MX missile, the basing mode, which was of great concern to Senator Cannon and, for that matter, to all of us in the west. Some of the medical things—the original report we had on bioequivalency I think helped to settle a lot of old arguments in the medical and in the drug community. All kinds of energy problems we have had a number of important studies.

I think it's vital to remember that OTA is not designed as a separate little power center running off making assessments. Perhaps our main mission is to serve the committees. If you are chairman of a major committee in dealing with something that is complex and as far-reaching and as threatening as the disposal of nuclear waste, you would really like to have an unbiased scientific panel to help you look down that road and see what problems could be anticipated.

So I believe, Mr. Chairman, that OTA is ripe, that it is now mature. I think the hearings that you have very properly called will help clear the air, and I hope will give us the underpinnings for continuing this to be a major arm of the Congress. It is often said that we are the third major arm, with the Library of Congress and the Legislative Reference Service, on information and bill-drafting and everything else; the oversight and investigative arm of the Congress, run by the GAO, and the scientific arm of the Congress, the OTA. I think we are now coming into position where we can honestly claim to be that third wheel, that third congressional institution that helps us do our job.

So I would hope the chairman and this committee would take a real look at OTA. I think, if you do, you will find what Senator Stevens and I have found, that while we made some mistakes in the beginning, while we had trouble getting this institution in place, that it is basically a good idea and ought to be continued, maybe modified in some way, but I don't have any specific changes to recommend. I think we are in pretty good shape.

If I can philosophize one more thing, and then I will quit: as we came from an agrarian society 150 years ago to a technological society and then to a new complex technological society on top of that, we have kind of had to reverse or treat a little carefully one of our main guidelines. It was never spelled out in the law or anything, but the American belief was that if science can do something, if technology can produce a new machine, a new drug, a new chemical, it's probably in our interest to use it, society ought to put it to work and not waste any time worrying about the ultimate consequences. And I think that was true as long as we were in a relatively low kind of technology compared to where we are now. The steam engine came along, we put it to use; many of the early chemicals and drugs, we put them to use; and whatever it was—the railroad, the airplane, the cotton gin. The assumption was: the technology is there, let's use it.

Now we are finding this much higher level of technology with drugs and chemicals that have extreme long-lasting effects, that maybe we can't be too sure and that we ought to plunge ahead a little less rapidly with some of these things where the scientists tell us there are possible threats. We stopped action, we made a national decision not to build the commercial supersonic transport; we know how to do it, the technology is there, we have proven it out in military applications—but it raised questions about the ozone, there were economic and cost questions about it. And we simply said: at this time we are not ready to go ahead as a nation. That was our decision. The British and the French did, and I think, looking back on it, it was probably a wise decision, particularly with the concern for the ozone layer and so forth.

Thalidomide, the deadly drug that made so many deformed babies when it was thought to be safe and wasn't; the events at Love Canal and down in the James River with kepone—all of these events suggest that as a wise country we have learned from the past, and that while we are going to continue to use technology and while we do have better living with chemistry in most cases, we ought to approach these things a little bit more slowly and with a little bit more concern for the side effects and the ultimate consequences.

One of the bills that is high on my agenda this year—I think we owe the country a decision on what we are going to do with high-level nuclear waste. If every nuclear plant were closed down today and all nuclear weapons were dumped in the ocean tomorrow, we would still have on our doorstep about 40 years of accumulated junk—high level, deadly, long half lives—and we haven't yet figured out any way to dispose of the first pound of this stuff. And I think we can do that, but it suggests again that maybe we go a little bit slow on some of these technological developments that have a high potential for far-reaching side effects and consequences.

So that would be my statement to you, Mr. Chairman. And good luck in this series of oversight hearings. I welcome them.

[The prepared statement of Representative Udall follows:]

PREPARED STATEMENT OF HON. MORRIS K. UDALL, VICE CHAIRMAN, TECHNOLOGY ASSESSMENT BOARD, OFFICE OF TECHNOLOGY ASSESSMENT

Mr. Chairman, I am delighted that the Committee on Rules has decided to conduct Senate oversight hearings on OTA. This is an appropriate time. OTA has crossed something of a watershed in its development. It has now been in operation for eight years. It is time to reflect on its record of achievement and to assess its future.

Mr. Chairman, as you know, I have been a member of the Technology Assessment Board since OTA's inception and have served both as its Chairman and Vice Chairman. I assumed this responsibility because I have long believed in the central importance of its work. Technology plays a critical role in a whole host of areas: in upgrading our national defense; in reducing our dependence on foreign oil; in conquering heart disease and cancer; in boosting the productivity of our workers; and even, and in providing an adequate supply of water to the Southwest, including the State of Arizona.

In all these areas, it is vital that Members of Congress have an adequate understanding of the hazards and potential of technology, if we are to grapple effectively with the problems. Members, of course, cannot possibly be familiar with all the latest scientific advances and their implications for public policy—thus, the need for OTA.

In its early years, OTA had more than its share of growing pains. During that time, I acknowledged its problems but tried to focus on its potential. It is no longer necessary to talk solely or even primarily in terms of its potential. Over the last few years OTA has compiled an impressive record of accomplishment. It has produced a virtual library of authoritative, relevant, and usable studies of some of the most perplexing problems that the government has had to face. How should we base the MX missile? How serious is the acid rain problem and what can be done about it? Should we build a supersonic transport? How can we manage the toxic radioactive wastes produced by nuclear power plants? How can American high technology industries be helped to compete more effectively in international markets? This is only a small sample of the very ambitious menu of topics OTA has taken on.

It is perhaps worth recalling how difficult an assignment was given to this new agency. It was to be a part of the Congress, overseen by a Congressional Board and servicing Congressional Committees; yet it was also to be nonpartisan, objective, and technically expert enough to command the respect of the professional scientific community. Its expertise was to cover the entire span of the physical, biological, and social sciences. It was not simply to analyze complex scientific and technological issues confronting the Congress—a difficult enough task. It was to help Congress anticipate issues that were not yet on the legislative agenda. It was to assess the full range of implications of technological change—economic, technical, social, environmental, political, military, health, etc.—as appropriate. It was to do all this in a manner that would fit Congressional timetables and Committee jurisdictions. This is a very tall order, indeed. What is remarkable is the extent to which OTA is now fulfilling its mandate.

The Office has acquired an international reputation among the professional scientific and technological community for the quality and authoritativeness of its work. Increasingly within the Congress, one hears comments acknowledging the high caliber of OTA's analysis. It is always difficult to provide hard measures of quality. Still, it is surely indicative that OTA's reports have become among GPO's "best sellers" and commercial publishers are now reprinting most OTA studies. Media attention given to OTA's findings and to the Office itself has been extensive and grows steadily. With your permission, Mr. Chairman, I will provide for the record a recent editorial from Science magazine and an article on OTA that appeared in Nature Magazine, the leading British journal concerned with science and technology. Foreign interest in OTA has increased rapidly as evidenced by the number of senior-level visitors from Europe and Asia that come to OTA in order to obtain first-hand knowledge of how the Office functions. Several European countries have legislation under consideration that would establish agencies analogous to OTA. France has recently established a Ministry of Technological Evaluation after careful examination of OTA. Most important, the volume of Congressional Committee requests for OTA assistance has risen steadily.

The House Interior Committee, which I chair, has been or will be the recipient of OTA assessments on the Development and Production Potential of Federal Coal Leases, Nuclear Powerplant Standardization, Technologies for Sustaining Tropical Forest Resources, Technology for Local Development, and Freshwater Resources Management, Planning and Policy. As Chairman of the Technology Assessment Board, I participated in a request that led to OTA's report on MX Missile Basing—also a subject of strong interest to my Committee. OTA is contributing to a GAO study requested by the Interior Committee on the Micronesian Compact of Free Association. These are major state-of-the-art studies notable for their authoritativeness and balance. The range of subjects is impressively broad. There are a number of other assessments (Nuclear Waste Management and Water-related Technologies for Arid Lands, for example) that touch on issues of major interest to the Interior Committee. The Committee has benefited, and I am sure will continue to benefit, from such assessments.

Finally, I would like to emphasize the value of the objective bi-partisan character of the Office. For a Congress in which the House and Senate are controlled by different parties, it is particularly important that Congress have access to in-house analysis that is both expert and done without consideration to partisan politics. OTA's bi-partisan, bi-cameral Board is unique among Congressional institutions and one whose value is particularly evident in the present context. The problems the United States will face in the years ahead will be complex and difficult and the resources available to deal with them are certainly not limitless. If we are to identify and implement coordinated, efficient solutions, we, the Congress, will require the best information and analyses obtainable. OTA is an important source of such assistance—more important now than ever before.

[From Science, May 15, 1981]

SCIENCE POLICY AND CONGRESS

(By William D. Carey)

Some instutitional innovations pay off. That is something to rejoice about, especially when they involve the performance of government in a public opinion climate that has made up its mind to be negative.

The Technology Assessment Act of 1972, fathered by then-Representative Emilio Q. Daddario, called for the creation of a professionalized center for studying the potentialities and impacts of emerging technologies. The Office of Technology Assessment (OTA) was established as an arm of Congress, designed to provide new depth and expertise to the work of committees of the House and Senate in dealing with technological controversy and risk, and complementing the efforts of the Congressional Research Service and the General Accounting Office.

Eight years later, OTA stands on its own feet as an effective and respected center of scientific and technological policy analysis. Its agenda is determined primarily by the questions put to it by committees and subcommittees charged with legislative responsibilites, although OTA has modest latitude to initiate studies under its own power. Quality control is seen to by a ten-member advisory council and an array of credentialed advisory panels, while a bipartisan congressional board of 12 members of the Senate and the House keeps OTA on target.

The roster of advisory panels provides a glimpse of the range of OTA's homework for Congress. The panels number 47 and cover a mind-boggling spectrum. There are panels on Advanced High-Speed Aircraft, Radio Frequency Use, Space Technology, Electronic Funds Transfer, National Information Systems, Technology and Oceanography, Strategies for Medical Technology, Population, Impacts of Applied Genetics, U.S. Industrial Competitiveness, MX Missile Basing, Soviet Energy, Nuclear Powerplant Standardization, and Energy from Biological Processes. All this produces an enviable knowledge base into which the responsible committees of Congress can dip when confronted with near-term and long-range problems of policy choice. Considering that the appropriation for OTA comes to eight-tenths of 1 percent of congressional operating budget, it would seem a modest enough investment in legislative capacity building.

A further point of interest is that there is no pretense that OTA is in business to make policy. This is a distinction better understood and practiced in Congress than in the Executive Branch, where presidential staff units come to believe that they are policy instruments of the President and behave accordingly. A very good reason for this difference is that Congress remains emphatically pluralistic and has nothing of the policy discipline that is so admired by the Executive Branch. A Office of Technology Assessment in Congress would not last long if it were to push a line of its own.

For most of our constitutional history, the Presidency has had the advantage over Congress in depth of resources for policy research and initiative. More recently, the institutional capacities of Congress have become steadily more comparable. The striking modernization of the General Accounting Office, the solid performance of the Congressional Research Service, and the impressive outputs of the Congressional Budget Office and OTA are healthy signs for all who value the principle of separation of powers. Although there are critics of the growth of the legislative payroll, Congress is aware that guess and hunch make for flawed policy.

Within the present decade we will observe the bicentennial of the Constitution, an occassion for some festivities, perhaps, but even more an occasion for examining the workings of our political technology in an age of danger and risk. Institutions in good working order reflect the better side of government.

[From Nature magazine, Oct. 8, 1981]

TECHNOLOGY ASSESSMENT WINS NEW FRIENDS

(By David Dickson)

Washington.—Two years off its tenth birthday, the United States Congress's Office of Technology Assessment (OTA) at last seems to be coming of age. By adopting a more pragmatic outlook OTA has generated a political and scientific credibility that makes its prospects more secure than ever before.

The change has its critics. "OTA is turning out good craft pieces that serve the interests of clients, but there is still a latent demand for something which is more policy- and futures-rich" says Dr. Joseph Coates, who was among the original staff members and recently left to establish his own consultancy firm.

But evidence of the new-found stability, which broadly coincides with the reign of OTA's present director, Dr. John Gibbons, previously head of the Energy, Environment and Resources Center at the University of Tennessee, was shown last week by the willingness of a Republican-dominated Senate, in a time of reduced federal spending, to increase the OTA's budget by 7.5 per cent next year to $12 million. Even though this will barely allow OTA to keep up with inflation, it compares with the budget to which the office has been held between 1980 and 1981.

When OTA was established by Congress in 1972, finally coming into being in November 1973, many saw it—with some justification—as a vehicle through which Democrat legislators hoped to challenge the scientific and technical decisions of the Nixon Administration following the demise of the Office of Science and Technology and the President's Science Advisory Committee.

OTA's new found friends, however, include conservative Republicans such as Senator Paul Laxalt of Nevada. Senator Laxalt is said to have been impressed by a recent study carried out by OTA comparing different basing modes for the MX missile which point out the advantages and drawbacks of each without endorsing a particular design, issues directly perintent to the debate about placing the missiles in his home state.

The importance of such friends emerged two weeks ago, when they helped to head off an attempt by Senator Mack Mattingly, chairman of the Senate approppriations subcommittee responsible for legislative affairs, to kill future funding for the OTA on the grounds that its studies duplicate the work of other bodies such as the Congressional Research Service.

It was a charge that was strongly denied by Dr. Gibbons in hearings on the OTA budget earlier this year. He pointed out that the cases quoted by Mr. Mattingly—for example of consulting firms carrying out the same work for different agenices—were several years old, and that with a tighter management structure and more narrowly defined missions OTA was now beginning to demonstrate unique value to Congress.

Much to OTA's relief, Senator Mattingly did not take his case to the floor of the Senate, and OTA's 1982 budget is now secure. "I presume it did not come up because a lot of people on both sides of the aisle have come to see OTA as a useful and important analytical tool", said Dr. Gibbons last week.

Much of the recent work, both long-term and short-term, has impressed OTA's congressional clients. "Some of their stuff is really excellent, particularly in the energy field" says one staff member of the House Science and Technology Committee. A recent report, *Impacts of Applied Genetics,* an analysis of the economic and commercial implications of genetic engineering applied to microorganisms, plants and animals, has been widely praised and recently reached the "top ten list" of government publications.

One secret of OTA's survival seems to be its greater awareness of the limits within which it can safely operate. The genetic engineering study, for example, avoided all discussion of the human applications as "beyond its scope"; and the MX study, while studying the "socio-economic" implications of the weapons' deployment, did not discuss political factors such as the full implications of local resistance. Dr. Gibbon explains this pragmatically. "Our job is to narrow the issues that must be fought out rather than to tell the politicans what they should do", he says. He talks of breaking problems down into "bite-size" pieces, referring, for example, to recent OTA studies on energy utilization and demand.

Dr. Gibbons is currentl;y trying to forge closer links with the National Academy of Sciences, as well as discusing ways of complementing the policy orientations of the Office of Science and Technology Policy. Drawing technology assessment more closely into the traditional nexus of political decision-making may have disenchanted some of its earlier enthusiasts. But it has proved to be a formula for political survival.

The **CHAIRMAN**. Thank you very much, Mr. Udall.

Senator **STEVENS**. Mr. Chairman, I make the same request, that my formal statement be printed in the record.

The **CHAIRMAN**. Without objection, so ordered.

Senator **STEVENS**. Let me emphasize——

Mr. **UDALL**. Let me hang on for just a minute; I want to hear what my leader has to say.

The **CHAIRMAN**. That's almost above and beyond the call of duty. [Laughter.]

Senator **STEVENS**. Let me emphasize the portion of my statement that refers to the concept of shared staff. I have come to the conclusion that without OTA, rather than reducing the expenditures of the Congress, we would actually increase Congress' expenditures. And if there is one thing the committee can do it is emphasize to committee chairmen on both sides of Congress that if there is a major area of technology that must be assessed, they should refer this to the OTA. If they do not—and a House committee chairman goes into a massive research project in terms of manpower and money, most assuredly the Senate committee is going to do the same thing. One way to assure that there is an apolitical analysis of technology and that that analysis is available to the Congress and every Member of the Congress is to assign the task to OTA.

I, too, welcome your review. Since I've been on OTA, I've insisted that we attempt to develop a track record of proven capability before we reach out and try to make the pitch we are making today. I think that track record is there; I think we have, as Congressman Udall indicated, gone through a period of suspicion, distrust, and skepticism. We are now at the position where OTA ought to be trusted by every Member of Congress to produce a product that is a good one and confined to the issues that were submitted to it.

In the last session of Congress, the MX studies I think reached that level of competence, and demonstrated really just how important that track record is.

We have also, through the MX study, demonstrated that the OTA staff can have access to highly classified limited access mate-

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rials of the Federal Government, can prepare an analysis in both the classified and declassified form, and can maintain the confidence that they have been given without any leaks or any form of security transgressions.

In short, Mr. Chairman, Senator Cannon, OTA is not without its problems, and I think your review will demonstrate where some of those problems are. All institutions have a tendency to perpetuate themselves in order to justify itself alone rather than to be continued on the basis of the work product it delivers. I do think that we always have to guard against the OTA becoming just another agency of the Federal Government. It is not.

The CHAIRMAN. Could I interrupt you there, because I think that is an extremely important point, and while Mr. Udall is still with us, to ask each of you this question: Do you think that the selection of projects, in other words, the making of the agenda for OTA, is adequately within the control of Members of Congress, or do you think that the staff of OTA has had too great an influence in selecting those projects that we will look at, projects that will be studied?

Mr. UDALL. My own opinion, Mr. Chairman, is that we have got about the right balance. Dr. Gibbons, the Director, can talk to this later, and will undoubtedly have figures on it. But I would suspect in the last 3 or 4 years that most of the major studies we have done have not come on initiative of the Technology Assessment Board but rather on requests of the committees. Now, you have got to have some control here, because there will be some committee chairmen who want to pass the buck on almost everything and see this as a method of delay and obfuscation of problems they are not ready to face. So we have the overall responsibility.

And I think, although we have been criticized a little bit, the OTA staff, for plunging ahead and suggesting things and dragging in matters that may be of some interest to somebody on the OTA staff but don't have great importance to the Nation or to the committee—I think there could have been some of that, but I don't see much of it around anymore. In fact, when the Board meets, it's very often we spend a good deal of time sorting this thing out and deciding whether this is really good for the country and good for technology assessment, or whether it is simply an attempt by a committee chairman to get somebody else to do his work. I think the Board has this potential problem under pretty good control; I think we are in pretty good shape on that.

Senator STEVENS. I think the problem really is that we are being asked more and more by committee chairmen and others to make studies which are not technology assessment. I am reminded of one request that we received to make an economic analysis of the Alaska natural gas pipeline. I refused to approve that, although it would have helped my State. It was not an assessment of technology, it was an economic analysis, and there are agencies in both the State and Federal Governments that can do that better.

One thing I would urge you to do is take a look and see if we have been right about the things that we consider to be technology assessment. Perhaps there should be some greater guidelines.

There is a tendency in some people's minds to classify as technology assessments analysis of the application of existing technology.

We have tried on the Board to make this distinction when we review these projects. I think the one real problem with your question, Mr. Chairman, is that within the day of a Member of either the House or the Senate, the time we have to put in that is necessary to review these agenda items before we get to the Board meeting is very limited. We are, just as everyone else is, I guess, in the Congress, put in the position of having to rely on our staffs to review the preparation of the OTA staff in making a judgment of whether or not the assessment should or should not go forward.

Now, I would think that it may be that instead of relying upon a request of the chairman, perhaps we ought to require in the future a vote of a committee and actual review by the committee of the assessment the chairman requests.

Senator STEVENS. That's what I was coming to next. The real problem is now I think the committee chairmen are viewing the OTA staff as a shared staff, but they want more of its time. And it's a way to shift to the OTA budget a portion of the burden of running a committee. If OTA does the work, and turns it over to both committees, the Congress is better off, but the question is who has borne the expense. We have not made a study—I haven't made a study of the allocation of dollars to particular committee efforts, and perhaps your staff could do that and see how fair we have been over the period we have developed this track record.

Mr. UDALL. We had a little bit of a flap about whether—the Director and the OTA staff, a couple of years ago, were preparing documents listing the suggested assessments that have been requested by others and the assessments that the staff had said were important and ought to be undertaken. And this was looked upon by some as kind of a power play in which the OTA staff was taking over.

And I didn't see it that way, and I don't think the concerns expressed were very valid. The OTA staff and Director ought to be looking ahead and talking with the scientific community and anticipating studies that might be needed, assessments that might be needed, and then bring them to the Board. The Board has the final authority on that.

The CHAIRMAN. I would agree with that, that probably the requests that would come in would reflect some objective need that had arisen, but not a perspective view.

Mr. UDALL. Sometimes very narrow. We haven't had a request for teenage chastity assessment yet, but there have been some about that wild a time or two.

The CHAIRMAN. Well, don't be discouraged; you may get it. [Laughter.]

Senator Cannon?

Senator CANNON. No questions, Mr. Chairman, thank you.

The CHAIRMAN. I had interrupted the Senator from Alaska, and I didn't mean to cut you off from completion of anything further that you wanted to say.

Senator STEVENS. Not at all, Mr. Chairman, I'm delighted.

[The prepared statement of Senator Stevens follows:]

PREPARED STATEMENT OF SENATOR TED STEVENS, CHAIRMAN, TECHNOLOGY ASSESSMENT BOARD, OFFICE OF TECHNOLOGY ASSESSMENT

Mr. Chairman, thank you for the opportunity to testify before the Committee as it examines the role of the Office of Technology Assessment as a Congressional support agency.

This is a timely review of OTA and the other support agencies. Congress' support agencies, like the rest of the Federal government, have demands on them which exceed their resources. As a member of the Legislative Branch Appropriations Subcommittee, I am acutely aware of the pressures on our support agencies.

The Technology Assessment Board during my Chairmanship has stressed that OTA should be considered by the committees of Congress as a shared staff. Our objective has been to reduce duplicative studies of complex technical questions facing Congress. The OTA study on MX Missile basing is a good case in point. Congress had a need for a technically competent study of a vitally important question affecting our long-term national security. Since its completion, the MX Study has been extensively used by both houses of Congress. I believe OTA should continue to emphasize its role of support agency to the committees.

There is no question that OTA has gone through some difficult times. However, in my opinion, the agency is running as smoothly now as it has at any time in its history. We do have problems and questions about OTA and the role it should play. The Rules and Administration Committee's decision to take a look at OTA should provide the Technology Assessment Board and the Congress with a good view of what it is we have and what we should be doing with the agency in the coming years.

You raised some questions about OTA which I'd like to address at this time.

How timely are OTA reports?

There have been problems with OTA producing a report of the type requested and in time to have an effect on pending legislation. Part of these problems have been administrative which Dr. Gibbons has been addressing since he became director. Dr. Gibbons has had some success to date and we are looking forward to continued improvement in OTA's performance.

Part of the problem goes beyond administration of the agency; it goes to the very nature of doing complex long-term studies when Congress itself works on two-year cycles. OTA reports frequently transcend Congress'. Particularly when there is significant change in the composition of a Congress like there was last year, the question is always going to come up about whether studies then in progress are relevant to the agenda of the new Congress. OTA went through an extensive process last year of reaffirming interest from the relevant committees in the ongoing work at the time.

The format of current OTA reports is a question I'm interested in. I hope you take a look at the question as well.

How well does OTA communicate with other agencies of the government and Congress in order to share information and avoid duplication?

Needless to say, the Board wants OTA to avoid duplication of effort as much as possible. There are very limited resources available to OTA as well as to the other agencies of Congress and the Federal Government. We should not be concerned about Congressional agencies doing research on things the Executive is doing work on. The reason for these support agencies is to provide the Congress with independent analysis of problems facing us. Attention should be given, though, to duplication of effort among the Congressional support agencies. Your look at all of the support agencies will provide us with a better idea of how well they do or do not coordinate their activities and research.

How well have key national issues been reflected in technology assessments requested by OTA?

This goes back to your first question, the timeliness of OTA's work. If one looks at OTA's recently completed assessments like the MX Missile Basing Assessment and Technology and Soviet Energy Availability, then I think it is safe to say OTA is involved in some of the main issues of our time. Upcoming assessments include a study on wetlands as the Environment and Public Works Committee prepares to consider the Clean Water Act, High-Level Radioactive Waste Management and Disposal, Potential U.S. Natural Gas Availability, and Evaluation of Veterans Administration Agent Orange Protocol. There are others, but the point is that OTA has been involved in the key issues before Congress.

The **CHAIRMAN**. Senator from Virginia?

Senator **WARNER**. No questions, Mr. Chairman.

Senator **Stevens**. Our thanks. We will look forward to the work product of this committee with anticipation, because some of us want to make certain that OTA survives, and I hear too many rumbles of dissatisfaction, so you can do the Congress a service by being very thorough in this review.

Mr. **Udall**. Thank you, Mr. Chairman.

The **Chairman**. I see in the room the distinguished Representative, George Brown, and we have a statement on his behalf which will be included in the record as if personally delivered, and with Congressman Brown's cooperation we will then call immediately upon Dr. Frederick C. Robbins, who is under some time pressure here this morning.

Dr. Robbins?

TESTIMONY OF FREDERICK C. ROBBINS, PRESIDENT, INSTITUTE OF MEDICINE, NATIONAL ACADEMY OF SCIENCES

Dr. **Robbins**. Thank you, Mr. Chairman. I, too, have submitted a written statement.

The **Chairman**. It will be included in full in the record, without objection.

Dr. **Robbins**. I will make my comments reasonably brief. Just to state my credentials, I have served on the Advisory Council of OTA since OTA was formed, and only a few months ago was retired, along with Dr. Jerry Weisner, as the last of the chartered members of that body.

I also have been involved with the health program of the Office, since, of course, that is my area of concern.

Now, my present location is president of the Institute of Medicine, which is a component of the National Academy of Sciences. Now, unfortunately, Dr. Frank Press, the president of the Academy, is out of town and could not be here. I understand he will be submitting a written statement. I will not necessarily speak for the Academy, but I would like to say that the Academy does respect the OTA, and I think has developed a feeling that the OTA is a competent organization and, indeed, in some areas developed into a formidable competitor.

I, too, saw some of the early struggles of OTA to develop its program, and I must say, for an agency with the budget it has, per dollar it must have been about the most investigated organization I can think of. One of the problems early in the game—and it still to some extent is true—is how you interpret the term "technology assessment," and what really comes under their venue.

There was a period, which is waning now I think, when technology assessment was regarded as almost becoming a specialty to itself. I would say that is less so now.

I would define "technology assessment"—and don't take this as the definitive word on this—as the means of examining the techniques and procedures we employ or may employ, most of which derive from scientific discovery, and their anticipated impacts. An assessment may be comprehensive or limited, depending upon need, but to be useful it really has to be and in most instances should deal with the broad range of effects, ranging from such relatively simple things as safety to the economic, social, and even ethical.

Now, the Office has done both kinds of study, and has tried to, as you know, meet the demands of Congress.

Another problem was defining its relationship to the Congressional Research Service and the General Accounting Office. That was anticipated and two members, the Director of GAO and the head of the Congressional Research Service, were members of the Council. And it's been my impression that these problems have been, to a large extent, dealt with, and that Congress now in these three agencies has a very fine, broadly based assistance group of agencies.

The Technology Assessment Advisory Council—TAAC, so-called—has also had some difficulty in the past defining its role. We did play a major role, I think, in helping define some of the methods to be used, to help decide what areas were important to assess, where to set priorities. We assisted in identifying candidates for the Director's position, and have tried to maintain some oversight of the quality of the program.

We have been somewhat less active in the last 2 years, and that is I think, because things have been moving rather smoothly and it has not been as necessary as it was earlier.

Now, the question: Are the studies appropriate and of good quality? Obviously there is some variation. But if one looks over the portfolio, one cannot help but be impressed with the range of things that have been done. And in those areas where I have the most knowledge, I can assure you that the quality is good.

I think the Office has maintained its ability to be objective and to provide a range of alternatives in their reports. They have called on the scientific community throughout the country—and here again the Advisory Council has played some role in serving as a link into that community, since most of us are scientists.

The principal problem I see with OTA, outside of its budget, of course, is avoiding becoming so preoccupied with the day-to-day problems that face Congress all the time that it loses perspective. I remember the first meeting I attended of the Advisory Council, and we were presented with the range of things we were supposed to deal with. Well, I came from a medical school and we deal with a pretty broad range of things. But I was absolutely stunned. Health, food, energy, defense—you name it, it's on the agenda. And I thought, well, this is an absolutely ridiculous proposition. Then I realized that that is what you in Congress are faced with every day.

So that I feel that it is important that Congress expect the OTA not only to do those things that are of immediate importance, but to help it in its anticipation of problems and identifying broad issues. Now, this isn't easy, and one must not expect too much. And there are other organizations, such as the National Academy of Sciences, the National Science Foundation Board, and others, that can help.

I would summarize to say that I am impressed with the progress that has been made; I think the relationships within the agency, between the Board and the administration of the Office, are the best I have ever seen them. And I think in this Office Congress has an important and useful tool that will help you to guide our course in a very technological age.

Thank you, sir.

The CHAIRMAN. Thank you, Dr. Robbins. The last point you made I think reflects the question I asked Senator Stevens and Congressman Udall, whether or not the direction of OTA, the selection of projects to be studied, was in the right balance. And in your written statement you perhaps state it more succinctly, when you say:

> The principal problem as I see it is that OTA will become so preoccupied with assisting the Congress with its day-to-day concerns that it will not be able to perform the comprehensive, forward-looking assessments of the many changes that are going on in our society, most involving science and technology * * *.

I think this is a troubling kind of question, because if you get too far ahead then you risk being awarded the Order of the Golden Fleece.

Dr. ROBBINS. Some people regard that as an honor. [Laughter.]

The CHAIRMAN. And if you slip too far behind, you are not giving us the amount of warning, the amount of notice, that we need in order to take corrective steps.

Now, as you heard Congressman Udall respond, he felt we had about the right balance. But let's think about your own specialty. Medicine, the health care profession, is one of the largest industries in America today. It has enormous impact on the economy. The President just the other day suggested that we make a rather radical change in the way we deliver health care to the Nation, so that Congress is going to have a direct, immediate involvement in this whole problem.

Are we looking ahead enough, or are we too bogged down with, as you suggest, the day-to-day concerns?

Dr. ROBBINS. I think all Government tends to be too preoccupied with day to day. That's almost an attribute. I think the OTA at one period in its career went so far into the long-range, broad, and, as I remember, holistic efforts that it clearly was no longer serving the Congress in the way Congress needs help. You do need help in the day-to-day issues, and you should get it.

But there has to be a portion of that effort that can look to the broader issues and help you to anticipate problems.

Now, the OTA cannot do all of that, but a certain portion of its time should be devoted to that. And the balance depends upon the judgment of the Board, help from the Advisory Council, and the expertise lodged in the staff and the advisory groups. All of these play a role in arriving at this kind of balance.

It's my impression in recent years the balance has been pretty good. Those of you who are dependent on the OTA, have used the OTA, will have to make your own decisions on this.

The CHAIRMAN. Senator Cannon?

Senator CANNON. Thank you, Doctor.

The CHAIRMAN. Senator Warner?

Senator WARNER. No questions, Mr. Chairman.

Dr. ROBBINS. Thank you, Senator.

[The prepared statement of Dr. Robbins follows:]

PREPARED STATEMENT OF FREDERICK C. ROBBINS, M.D., PRESIDENT, INSTITUTE OF MEDICINE, NATIONAL ACADEMY OF SCIENCES

Mr. Chairman, thank you for providing me the opportunity to comment upon the performance of the Office of Technology Assessment. My formal testimony will not be extensive, but I assure you this in no way indicates any lack of interest in the subject.

I am Dr. Frederick C. Robbins, President of the Institute of Medicine. My knowledge of the Office of Technology Assessment comes from having served on the Advisory Council and as a member of the Advisory Committee to the Health Program. I was appointed to the Council at the time of the creation of OTA and served until the fall of 1981 when I was no longer eligible for reappointment. Dr. Jerome Weisner and I retired at the same time and were the last of the original, charter members. During my term I served as vice chairman and chairman. In addition to my role as a member of the Council, I was chairman of the Health Advisory Committee, a position that I resigned when I became President of the IOM, but I have remained a member of the committee. Thus, my association with the OTA dates from its inception, and I have had the opportunity to observe its efforts to define and fulfill its mission. I am impressed that at the present time OTA serves an important role for the Congress and that it does it well.

The path of the OTA has not been entirely a smooth one. It seems to me that considering its small size, the OTA must be one of the most carefully scrutinized agencies in government. One of the problems it has had is the result of its name. Few people were familiar with the term "technology assessment" and indeed even today it is not a household word. There was a tendency originally to interpret the term "technology assessment" very narrowly. I will not attempt to give a definite definition of technology assessment but to me it means examining the techniques and procedures we employ, or may employ, most of which derive from scientific discovery for their anticipated impacts. The assessment may be comprehensive or limited, depending upon need, but to be useful most assessments should consider a broad range of effects including safety, economic, social and even ethical.

As things have evolved, the Office deals with technical and scientific issues in various ways but always attempting to provide Congress with as complete an analysis as possible of the problem, the range of policy options, and the anticipated impact of each one. It conducts both studies of short duration and limited scope as well as more extensive ones dealing with broad issues. Another function that has been served to some extent has been to identify problems that promise to become important in the foreseeable future particularly those that Congress should be aware of. It seems to me that an important feature in what I consider to be the successful development of OTA is the evolution of the understanding by the Board of OTA, members of Congress, and the staffs of the congressional committees of how to use the Office to best advantage.

A problem that OTA early faced was the need to define the separate roles of the other congressional investigative agencies, GAO and CRS. The participation of the Directors of these two agencies on the Advisory Council has been helpful in working out these relationships. Although there are some overlaps among the activities of OTA, GAO, and CRS, it has been my observation that the functions, modes of operation, and resources are sufficiently different and complementary that, with the kind of regular interaction that has been developed, they offer together an extraordinary resource.

Another mechanism, chartered by Congress in 1863 to provide the government with advice in scientific and technical matters, is the National Academy of Sciences complex that includes the National Research Council and the Institute of Medicine. There is some potential confusion of the roles between the NAS and OTA. They use similar modes of operation and draw on the scientific expertise of the country for advice. However, there are major differences, the most significant of which is that the NAS, although chartered by Congress, is an independent unit which conducts studies on contract when requested by any branch of government as well as for some private sponsors, whereas OTA is a congressional office with a budget provided by Congress and responds directly to its specific needs.

As you are aware, the OTA is governed by the Congressional Board. In the organizational scheme, TAAC, on which I served, is advisory to the Board. The members of the Council have been distinguished persons and have been conscientious in discharging their responsibilities. In the early days they helped the Office develop its methods of operation and served as a bridge from OTA to the broad scientific and technical community. They assisted in identifying candidates for director of the agency, helped to establish priorities, and to define the scope of individual projects.

Since the Office has become better established and the staff more secure in their role, TAAC has been somewhat less active. This is probably a sign that things are going well. However, TAAC does continue to plan an oversight role and is particularly concerned with the quality of the product and on a regular basis communicates its observations to the Board. Relations among the Director, Board and TAAC have been for the most part cordial and are particularly so at this time. However, realistically, the amount of direct contact between the Board and TAAC is not great. The members of both bodies are busy people and it has proved difficult to arrange for much personal interchange. The Council and the Director and his senior staff do interact effectively and the Council communicates its findings to the Board in writing. Although this seems to be a satisfactory and realistic arrangement, members of the Council at times have expressed some disappointment that they were not more intimately involved in the affairs of the Office and had so little contact with the Board.

On the whole, it is my impression that the products of OTA have been of high quality and some truly outstanding. As might be expected, there has been some difference in quality among reports and the various divisions of the Office, but the staff has been willing to recognize shortcomings and deal with them promptly.

It is my observation that the staff of the Office has been, on average, of high quality. They address their task with great seriousness and a commitment of objectivity and quality. The consultants, both individual and commercial, whom they have used have been carefully selected and, in the areas about which I have special knowledge, are among the best available in the country. Of course, I can comment most knowledgeably about the activities in the Health Program. This is not one of the largest but is of high quality. Among the staff are some who are recognized both nationally and internationally as authorities in the field. The reports have been well received and indeed one or two are almost classics. Among the more notable ones I will mention is one entitled, "Development of Medical Technology: Opportunities for Assessment." This dealt with the methodology of assessment in the health field and some of its complexities. It has had wide circulation and is used in some places as a text. The review of the "Policy Implications of the Computed Tomographic (CT) Scanner" was an important and very useful study. Likewise, the series of reports on immunization policies has been widely quoted outside Congress as well as internally. The recent review of the techniques of cost benefit/cost effectiveness analysis and their usefulness in policy analysis, along with a series of case studies, is a significant contribution. I have selected these few reports to mention expecially but there are a number of others that I could have chosen.

It seems to me that as measures of the quality and utility of the products of the Office, we can use the response of the principal client, Congress, as well as that of the broader concerned public. It is my impression that there has been a steady increase in the demands from Congress to the Office and more interest in and satisfaction with the product. Furthermore, the demand for the reports from the outside is surprisingly and gratifyingly great. Indeed, some of the reports are being published by special arrangement by commercial houses for even wider distribution. You have been presented data documenting these statements from the Director.

Finally I would like to take note of the fact that TAAC has been impressed, particularly in recent years, with the efficient management of the Office.

In summary, the OTA provides the Congress an important and essential service. It does so objectively and with excellent quality complementing the other resources available to Congress. At this time in the history of our country, scientific and technical issues are assuming even greater importance than ever before and those responsible for setting policy will be even more in need of objective, expert analyses of a wide array of incredibly complex issues.

The principal problem as I see it is that OTA will become so preoccupied with assisting the Congress with its day-to-day concerns that it will not be able to perform the comprehensive, forward-looking assessments of the many changes that are going on in our society, most involving science and technology, that are needed in order to anticipate trouble—the "early warning" function. This is not an easy task and requires a sophisticated long-range multidisciplinary approach that cannot be applied to every problem. However, Congress will be better served if it expects OTA to direct some of its resources in this way. Like it or not, we are living in a technologic society and there is no retreat.

The **CHAIRMAN**. Thank you very much. I am advised that Representative Brown would like to say just a word at this point to supplement his statement, which is already a part of the record.

TESTIMONY OF HON. GEORGE E. BROWN, JR., A REPRESENTATIVE FROM THE STATE OF CALIFORNIA

Mr. **Brown**. Thank you, Mr. Chairman. I think this is a protocol matter more than anything else; you don't have me over here without letting me say a word or two. I really can't contribute much beyond what the distinguished Chairman of the OTA Board, and the Vice Chairman, have already said. I bring my own perspective to this, but these two gentlemen have done an excellent job of leading the Board, and Dr. Gibbons, who will testify later on this morning, I think has an excellent statement outlining the work of the Board. I've been associated with Technology Assessment since the mid-sixties in the drafting of the original legislation. I am aware—I think I am aware of the main problems which face the operation. They have been touched on by the previous speakers.

We have a problem of defining precisely what our mission is, and it's probably not possible to define it precisely. But it is possible to have a good, reasonably clear idea, and I think that's what we need to focus on.

And we also need to be extremely clear about the relationship within the OTA operation, the Board, and the Congress, and particularly the leaders of the committees of the Congress. Very honestly, OTA is part of the process of policy analysis that goes on here. It's an important and specialized part, dealing with the effort to forecast and to assess impacts of changes that will take place related to scientific and technological development, and all of the members of this committee, I am sure, are well aware of the importance of this.

But we can stray too broadly, as Dr. Robbins has indicated and others have indicated; we can get off into extraneous areas and tangents; we can focus too far in the future or we can stay too close to the present. That takes judgment to determine what needs to be done there.

Frankly, the quality of the policy analysis and then the final decisionmaking, which can only be done by the Congress, depends upon the capability of the Members of the Congress to understand the complexity of these scientific and technological issues, and this is the contribution that OTA is supposed to make, just as in a broader sense our Nation is at peril because it is not sufficiently literate in a scientific and technological sense, and we are being outstripped by other societies in this regard.

So the Congress can be deficient in its ability to make these crucial policy decisions in highly scientific and technological areas unless it takes the trouble to assimilate the background, the alternatives, the impacts—and this is the contribution which the OTA seeks to make.

I would hope that the process which I have seen continuing and improving, of better liaison between the committee members, the committee staffs, and the OTA—I would hope that that will continue, that it will be encouraged, that we will understand more clearly the service that the OTA can offer, and that the net result will be, as we hoped it would a generation ago when the word first was coined, that it would lead to our ability to solve problems of increasing complexity in a way which is more compatible with the needs of the American people.

Let me stop at that point, Senator, and if you have any questions I would be happy to answer them.

The CHAIRMAN. Let me ask Senator Cannon if he has any questions.

Senator CANNON. Thank you very much, Congressman Brown.

The CHAIRMAN. Senator Warner?

Senator WARNER. No questions, Mr. Chairman.

The CHAIRMAN. We appreciate both your being here today in person and the thoughtful statement that has already been entered in the record.

I share with you the sense of need for an even greater coordination of what OTA provides with what Congress needs, and I think that literally the face of America can be affected in a positive way by this kind of coordination.

Mr. BROWN. I certainly agree with that, Senator, and it is not a substitute for hard work on the part of the committee chairmen and the Members of the House and Senate, of course; it's an aid.

The CHAIRMAN. No, but it seems to me that it provides a kind of a reflective ingredient that, as Dr. Robbins suggested, in our day-to-day concerns, may be absent. If we are going to look ahead and say not just how do you pour this concrete and how do you provide the funds for pouring this concrete, but what kind of societal changes are going to flow from it.

Mr. BROWN. Well, Senator, let me just make a point that has been made already. In my opinion, as a fairly close observer of the operation, and admittedly biased in its favor, there has been a noticeable improvement in both the definition of its function and in the quality of the work that has been produced over the last 3 or 4 years.

The CHAIRMAN. Let me ask you this one question. Do you think that the warning lights have been sufficiently visible, the Klaxon has been sufficiently audible, so that the committees of Congress have gotten the message from the studies that OTA has undertaken?

Mr. BROWN. If I understand your question, I am not at all sure that we have met the need yet for a better grasp of what the future holds in those areas impacted by science and technology. Frankly, the pace of change continues to increase, the needs continue to get greater. I think we are going to see things happen that almost stagger the mind of man, and we have a responsibility to make a much stronger effort than we have to forecast, anticipate, and assess these kinds of things.

The CHAIRMAN. Well, I agree with you, and I am not afraid of the future—I think the future has some great opportunities in it, and it can be very good. But what I am really asking you is this: Do you think that when OTA is seized of some fact of importance that that fact is sufficiently known to the committees of Congress who are dealing in that area, or do we need to have some better means of communication so that before the committees act, before they write the reports, before they send bills to the floor, they are thoroughly aware of what OTA has within its possession?

Mr. **Brown**. That has been one of the problem areas of OTA, but it is also one of the areas in which I think we have made the largest steps toward improvement. The communication process is now immeasurably better than it was 5 years ago.

The **Chairman**. Does OTA even know that a committee is working on an area that it has already studied?

Mr. **Brown**. The OTA maintains a liaison process which Dr. Gibbons can describe to you in more detail, which is aimed at precisely that problem.

The **Chairman**. Thank you very much.

[The prepared statement of Representative Brown follows:]

PREPARED STATEMENT OF HON. GEORGE E. BROWN, JR., A REPRESENTATIVE FROM THE STATE OF CALIFORNIA

Mr. Chairman, I am pleased that the Senate Committee on Rules and Administration has undertaken these oversight hearings on the Congressional Office of Technology Assessment.

As an original author of the Technology Assessment Act of 1972, and a member of OTA's governing body, the Technology Assessment Board, I have had the opportunity to closely observe the work that OTA does. I have been pleased with OTA's performance over the years and value its contribution to the legislative process.

As legislators, we all suffer from shortsightedness. We focus on the crisis of the moment and are forced by a number of constraints to propose specific solutions to specific problems. These narrowly focused, single-purpose approaches frequently provide short-term relief but cause worse problems in the long run. We may also find that the original problem has been dealt with but problems have been created in other areas.

We can avoid these situations only by undertaking a multidisciplinary, comprehensive investigation of an issue. This is beyond the capacity of our personal and Committee staff but is one of OTA's primary functions. On each OTA assessment, a panel is selected, consisting of experts who represent a variety of viewpoints and disciplines associated with the issue under study. This advisory panel steers the assessment through all of its phases, from drawing up the outline to reviewing the final draft of the report.

The result of this process is a detailed scientific and technological issue analysis which is free frim bias and manipulation by any vested interests involved. It is an analysis which compliments the functions of OTA's sister agencies, the Congressional Research Service, the General Accounting Office, and the Congressional Budget Office. But contrary to the misperceptions of some, OTA does not duplicate the functions of these other agencies. Only OTA has the special charge to examine pressing technological issues.

We are increasingly faced with making legislative decisions which involve complex technologies and their effects upon society. Typical of this are issues involving areas such as genetic engineering, computer technologies, and missile basing modes. In other instances, we are being forced to revise laws because of technological advances. The painful process of rewriting our telecommunications regulation statutes is an example of this type of legislative issue. If we are to enact legislation which will cause these technologies to fairly and justly serve society for years to come, where will we gain the detailed, unbiased background information which we require?

In my estimation, only OTA can perform this function for us. OTA has undertaken assessments in each of the areas which I have just mentioned and they stand as proof of OTA's value to Congress. Without these assessments, without OTA, we would have to perform this function ourselves on an ad hoc basis, and I guarantee you that we could not equal the quality of OTA's work.

Many OTA assessments are of such quality that they are picked up by commercial publishing houses. I am told that the recent OTA assessment on genetic engineering is being translated into Japanese for publication in that country. I know of few other Congressional documents which have achieved that level of excellence.

I know that there are some who question the need for OTA, people who, apparently question the need for an informed decision-making process in Congress. I would ask these people to take a look at decisions made by Congress without the benefit of good scientific and technological analysis. Look at the decisions we have made on nuclear technologies, decisions made for the most part, without benefit of an understanding of the scientific and technological issues involved. Look at the situations we have stumbled into in the field of toxic chemicals over the years, and the decisions we have made without benefit of good, unbiased scientific analysis. Look at the defense programs which we have started and then cancelled once the technological barriers to these programs finally emerged. Does anyone here remember the push to build a nuclear powered airplane in the 50's and 60's? That fruitless endeavor only cost a billion dollars and was, at that time, a technological impossibility.

We should be proud to have this agency at our disposal. It is not a luxury that we cannot afford. It is a necessity that we must have if we are to be responsible legislators.

The CHAIRMAN. Our next witness is Dr. John B. Slaughter, the Director of the National Science Foundation.

TESTIMONY OF DR. JOHN B. SLAUGHTER, DIRECTOR, NATIONAL SCIENCE FOUNDATION

Dr. SLAUGHTER. Senator Mathias, gentlemen. I am pleased to have the opportunity to share some thoughts concerning the relationship between the National Science Foundation and the Office of Technology Assessment. I have submitted a copy of my statement for inclusion in the record.

The CHAIRMAN. Without objection, your statement will be included in the record as if read.

Dr. SLAUGHTER. Thank you, sir. I will highlight some of the points made in that statement.

We are fully aware and supportive of the whole question of technology assessment. And we understand the concept used when Congress considered the need for an Office of Technology Assessment as an early warning of issues that might prove critical to our country.

The assessment activities of the National Science Foundation and the Office of Technology Assessment, we believe, are mutually supportive of one another.

There are a number of issues, many raised by the persons who have already spoken, concerning technology assessment. One needs to realize, however that factors other than technical issues must be taken into account. These factors may include economic, social, and political aspects.

We have a severe problem sometimes of understanding those aspects of technology assessment which are more qualitative and somewhat less tangible than those which can be stated in terms of mathematical equations or technical considerations. A great deal of the methodological research supported by the National Science Foundation is aimed at trying to improve our knowledge of those kinds of matters. We believe that such knowledge can then complement the studies done by the Office of Technology Assessment.

I am optimistic, as a matter of fact, about the improvements that have taken place in technology assessment, but I am aware also that there are a number of problems. We have a problem of timing in many cases: a problem of learning how soon we can begin to make an assessment about an emerging technology. Sometimes if we get too far out front in attempting to make an assessment, we miss information critical to our understanding that may come along later. If we wait too long then the sands of time move too far, and we find that we have failed to anticipate matters of great importance. Consequently, we have a dilemma, a dilemma of timing.

We can sometimes miss some of the most important technological activities simply because we are not there with the resources at the right time.

It has already been mentioned that at times we are so wrapped up in addressing the immediate problems that we fail to take the looks that need to be taken. And that just reminds me of the old statement that we face the never-ending dilemma of the urgent driving out the important.

Technology assessment must be addressed to emerging issues rather than to the pressing problems of today or of the past. The functions must be anticipatory rather than corrective or reactive. Policymakers must be able to respond flexibly, imaginatively, and in such a way that strategies can be developed for handling uncertainties. That is why we believe that the role of the National Science Foundation in support of and complementing the Office of Technology Assessment provides a considerable amount of strength to policymakers.

There must be, and there is, a close relationship between the Congress and the Office of Technology Assessment. In our opinion, the attention of the Office to the present and immediate future rather than to long-term issues is appropriate. The National Science Foundation has the responsibility to examine the longer term, higher risk research activities. The methodological research that we are supporting in support of technology assessment is an indication of this division of effort.

There is another dimension that we believe is important. Our methodological support, which looks more broadly at the development of knowledge, supports the case-by-case kind of attention given by the Office of Technology Assessment. The Authorization Act of 1979 specifically called out this function and encouraged the National Science Foundation to continue studies concerned with the development of methodology and to support the kinds of research that in turn could support the OTA activities.

The committee said:

> To the extent that improvements in assessment tools and methods are available or developable, the Committee urges the National Science Foundation to support such programs . . . .

The public law which established OTA provides for its coordination with our agency. I think that coordination is going exceedingly well. Dr. Gibbons and his staff meet quarterly, and more often, if necessary, with Dr. Joshua Menkes, the leader of our Technology Assessment and Risk Analysis Group and his staff. The OTA staff also is invited to participate in reviewing candidate technology assessment research projects at NSF. I am delighted that that kind of coordination takes place, and I am pleased that both groups share a genuine feeling of cooperation and collegial respect.

The scope of the OTA assessments, I think, is truly impressive; let me just mention three of them.

There is a current OTA project on atmospheric alterations. Perhaps no issue is more important than the quality of our atmosphere; the question of acid rain is one that is with us and will continue to be with us until we solve the problems. The basic research we are supporting at the Foundation is concerned with the long-term problems of atmospheric chemistry. We are examining the presence of sulfuric compounds in the atmosphere, how they turn into acid sulfates; and how to identify atmospheric oxidizing agents that affect the conversion of these dioxides into acid components. We also are studying the composition and distribution of airborne dust that can neutralize atmospheric acidity. These are the kinds of long-term studies we are doing that will support the OTA assessment.

Another OTA project involves research in molecular biology, which has been supported by the National Science Foundation for some time. Such research is now emerging as a result of the great emphasis on genetic engineering. The chairman in his opening comments pointed out the significance of that particular set of developments, and the OTA study in this field is timely.

Concern about the application of genetic engineering to the improvement of crop plants and to useful chemicals and drugs makes exceedingly timely the OTA studies on the impacts of applied genetics and comparative assessment of commercial development of biotechnology. It is important to the national interest—more so perhaps than any other issue facing us—because of the costs, benefits, legal and ethical considerations, and social impacts associated with commercializing genetic engineering products.

And a third area is the question of information technology, that ever-increasing giant technological area in this Nation. The National Science Foundation has supported research in information sciences and computer sciences since their early beginnings. Now the Office of Technology Assessment is examining the whole question of how we are going to see continued development and impacts of the progress in information processing, telecommunication technologies, and the many new technological enterprises being driven by the rapid advances taking place in computers and information sciences.

Let me summarize by saying that I think there is no more important issue facing us than understanding fully the interactions of society with technology. Technology has been a central force in this country, and will continue to be so. In my opinion, the original goal that the Congress articulated for OTA is still the right one. It is to provide improved information and analytical input to the legislative process so that management decisions can insure the realization of full benefits from our knowledge and minimize the unwanted, unintended, and unanticipated consequences of applied science.

Mr. Chairman, I repeat that I am pleased to be here to comment during this important set of hearings. I would like to close on a personal note by commending Dr. Gibbons and his staff for the excellent and difficult job that I believe they are performing.

[The prepared statement of Dr. Slaughter follows:]

PREPARED STATEMENT OF DR. JOHN B. SLAUGHTER, DIRECTOR, NATIONAL SCIENCE FOUNDATION

Mr. Chairman, I am pleased to participate in this, the first Office of Technology Assessment (OTA) Oversight hearing in the U.S. Senate.

The concept of technology assessment evolved from the deliberations of the U.S. Congress in the late 1960's. The need which was articulated then for an early warning signal concerning the implications of major technology-related decisions is still the principal justification for the assessment activities of both OTA and the NSF.

Their programs are based on the belief that they can help meet the need for better informed decision- and policy-making.

Information developed in technology assessment projects includes not only technical data but also economic, social, and political material. The Foundation is very much concerned with the need to improve the ability to understand the less-quantified, nontechnical aspects of technology, so that they may be better dealt with by experts and nonexperts alike. Most of the methodological research supported by the Foundation is concentrated on this aspect.

Although I am optimistic about the progress being made, there are practical difficulties in making technology assessments serve the goals we have established. If we are to anticipate the consequences of future technical choices, the pertinent information must be developed early. But efforts to do so are often hindered by the political reality which generates pressures to develop information perceived to be of immediate importance; this imposes a severe discount on information not currently needed.

Consequently, we face a dilemma: if we are free to develop information in advance—so that it may be used in a timely manner—it may miss the mark or be ignored in the heat of the day's concerns. If we wait until the problems become more critical, it may be easier to frame the concrete issues but more difficult to collect and use the information before fateful decisions must be made; indeed, some desirable options may have already been foreclosed. In sum, we must walk a fine line between responding to urgent problems of the day and providing early warning of potentially irreversible and detrimental changes.

Here again, to be of the greatest use, technology assessment should be addressed to emerging issues rather than pressing problems of the present—or the past. The function of technology assessment should be anticipatory rather than corrective or reactive. Its approach should enable policymakers to respond flexibily, to plan imaginatively, and to develop strategies for the handling of inherent uncertainties. In this connection I should mention that NSF attempts to be sensitive and responsive to the needs of potential users of assessments.

I need not belabor the point that the intimate relationship that exists between the U.S. Congress and the Office of Technology Assessment favors attention to the present and the immediate future, whereas the research orientation of the Foundation allows us to pursue the assessment of technologies which may have major impacts in later years. This emphasis on the future is not without risks. An issue which looms large when contemplated from a distance of ten or fifteen years may not materialize as we acquire more information about it. But since the reverse is also true in our era of galloping changes, the risks need to be taken.

There is yet another dimension that distinguishes the NSF technology assessment program from that of OTA. The focus of the NSF program is on methodological development, which complements the case-by-case focus of OTA. The appropriateness of this division of labor was specifically noted by the House Committee on Science and Technology in its 1979 NSF Authorization Report. The Committee observed that universities and similar institutions are the natural developers and repositories of the skills needed for methodological development: "To the extent that improvements in assessment tools and methods are available or developable, the Committee urges the National Science Foundation to support such programs. . . ." (HCST, Report No. 96-61, page 28).

The Public Law (Section 10, 92-484) which established the Office of Technology Assessment provides for its coordination with the National Science Foundation. I am pleased to state that successful coordination is being achieved with Dr. Gibbons and his staff through quarterly meetings with Dr. Joshua Menkes, the Group Leader of the Technology Assessment and Risk Analysis (TARA) Group, and his staff. We also routinely invite the OTA staff to review candidate technology assessment research projects.

The scope of OTA assessments—some completed and some still underway—is truly impressive. I will restrict my comments on specific assessments to a few, where the Foundation is involved in basic research.

The current OTA project on Impacts of Atmospheric Alterations is extremely important. It should result in sound advice for the consideration of Congress, for here our basic research is developing knowledge to deal with very long term problems. For example, NSF is supporting basic research on atmospheric chemistry in topics such as the role of clouds in the conversion of sulfur dioxide to acid sulfates, the identification of atmospheric oxidizing agents that effect this transformation, and the composition and distribution of airborne dusts that can neutralize atmospheric acidity.

Basic research in molecular biology conducted in the 1950's and 1960's provided knowledge which has led to our recent exciting breakthough in genetic engineering. Much of that research was supported by NSF. We continue to support such research, including that aimed at the application of genetic engineering to the improvement of crop plants, food animals, industrial micro-organisms, and new ways to produce useful chemicals and drugs. The OTA studies on the Impacts of Applied Genetics and the Comparative Assessment of Commercial Development of Biotechnology are clearly very timely. They are very important to the national interest in drawing attention to issues of costs and benefits, legal and ethical considerations, and social impacts which may be associated with the commericalization of genetic engineering products.

There are also several important projects that OTA has done in the area of information technology. NSF-supported research in computer sciences provides much of the basic foundation for the development of powerful information-processing capabilities which keep the U.S. a world leader in this field. As we move towards a more information-intensive society, studies by OTA on information systems, telecommunication technologies and other new technological enterprises provide important insights needed to steer a prudent policy course into the future—by anticipating various effects on society.

In summary, let me emphasize my belief in the importance of understanding the interactions of society with technology. Technology has been a central force in America during our first two centuries of develoment. I strongly endorse the original goal Congress articulated for OTA: to provide "improved information and analytical input to the legislative process so that our management decisions can insure the realization of full benefits from our knowldge and minimize the unwanted, unintended, and unanticipated consequences of applied science." (U.S. Congress, House of Representatives, Committee on Science and Astronautics, "Technology Assessment," Hearing before the Subcommittee on Science, Research and Development, 91st Congress, p. 1, 1969.)

I would like to close with your permission, Mr. Chairman, on a personal note and congratulate Dr. Gibbons on an important and difficult job well done. This concludes my prepared testimony. I shall be happy to answer any questions.

The CHAIRMAN. Thank you very much, Dr. Slaughter. Senator Cannon?

Senator CANNON. Thank you, Dr. Slaughter.

The CHAIRMAN. Let me ask you whether you think there is a sufficient communication between the scientific community, particularly with respect to the perspective to the possible impact of scientific advances in the political world where the implementing decisions are made.

Dr. SLAUGHTER. Senator, that is an exceedingly important question. From your vantage point and observation of some of the activities of science, from the committees you served on over the years, I am sure that you have observed an increasing awareness on the part of the scientific community of the importance of tying the results of basic research to applications of science.

I think we are in a period when scientists realize a social factor must be taken into consideration in their discoveries. I am impressed by the increased communication and interaction occurring in the area that you just mentioned.

The CHAIRMAN. You say you are impressed.

Dr. SLAUGHTER. Yes, I am.

The CHAIRMAN. Well, it is so necessary. I recall some years ago where the Rockefeller Institute went out to Southeast Asia, out to some of the island communities, and virtually eradicated a kind of typhoid which was particularly virulent among adolescents. And this was a great humanitarian thing to have done. But the result was that within a year or two those adolescents became adults and became parents themselves, and as a result there was a very rapid demographic change—there was widespread unemployment, there was famine, there was political and social upheaval, all the result of the most well-meaning kind of medical program, and highly successful medical program.

Now, that, again, is a kind of gross example of the need for exchange of knowledge between the scientific and the political communities, because all of those unfortunate and negative aspects of a very positive program could have been avoided if there had been the kind of communication and an understanding of exactly what was going to flow from this medical program.

Well, I think we need your continuing advice and counsel on how to enhance that communication, and I am glad you feel that it is moving in the right direction.

Dr. SLAUGHTER. We are most anxious to assist. Your example reminded me of the importance of understanding ecosystem balances and the impact of making a perturbation in any part of the food chain; that is a central problem.

The CHAIRMAN. Well, I am sure Senator Cannon won't be offended if I say that you shouldn't rely on our ability to divine these things in some psychic way—somebody is going to have to tell us. As Dr. Robbins suggested, we are generalists in the most general sense, and we do our best, but we really rely on the information that people give us on the facts and figures that are supplied to us, either through these formal hearings or through more informal communications.

So the scientific community ought to be on notice that we have to be told. We are not going to get it from some kind of divine inspiration.

Dr. SLAUGHTER. I would assure you, sir, that I will take that message back to the community, and we are doing so in a number of ways, emphasizing the importance of response from the community.

The CHAIRMAN. Well, when you take the message back you might remind them of Mr. Dooley's description of how you will have to communicate with a Congressman—and, Representative Brown, I assure you I include the Senate within that definition of a Congressman—but Mr. Dooley said you have to hit him over the head. Hit him in the snout is even a more direct quotation, as it comes back to me. [Laughter.]

So hit us in the snout. We need it.

Dr. SLAUGHTER. I assure you we will do that figuratively rather than literally. [Laughter.]

The CHAIRMAN. Well, sometimes it may have to be literally. Thank you very much.

Dr. SLAUGHTER. Thank you.

The CHAIRMAN. Now, our final witness this morning is Dr. John H. Gibbons, the Director of the Office of Technology Assessment.

Dr. Gibbons, we have a copy of your statement, and, without objection, the statement in full will be included as part of the record, and we will ask you to comment as you see fit.

TESTIMONY OF DR. JOHN H. GIBBONS, DIRECTOR, OFFICE OF TECHNOLOGY ASSESSMENT

Dr. GIBBONS. Thank you, Mr. Chairman. I will summarize my written testimony for you this morning and cover briefly OTA's mission, its capabilities, its methods and procedures, and then speak to the performance of the agency in terms of the importance of the issues that we address, the quality and productivity of our work, the usefulness of those products, and finally a few words about its impact.

Technology is certainly critical to our national future. I don't think there is any argument about that. Increased productivity and consequent economic vitality must derive in large measure from technological innovation. Technology is also needed to control the potential negative consequences of technology-driven growth, including environmental damage and job displacement. If national defense capabilities are to be significantly upgraded, technology will play a central role. Similarly, the promise of better health of the public rests in large part on improvements in medical and health care delivery technologies. In short, we live in a very high-technology era.

The act which created OTA and the legislative history indicate that the Office was established as Congress's own source of nonpartisan technical expertise and analysis. OTA is responsible for providing Congress with the best possible synthesis of national wisdom on public issues involving science and technology.

With its broad technical expertise, OTA serves as a shared staff on matters related to technology and policy to the committees of the Senate and House. Many of our studies are carried out in response to requests from more than one committee. For example, the requesters for our study on technologies for sustaining tropical forest resources include the House Committee on Foreign Affairs and the Senate Committee on Energy and Natural Resources. That study was also supported by letters from the House Committee on Interior and Insular Affairs and the Senate Committee on Environment and Public Works. I provide other examples, Mr. Chairman, in my text, which demonstrates the fact that we are taking on studies in which there is a multiplicity of committee interests in both the House and Senate, frequently supported both by the majority and the minority members of the committees.

OTA was created because Congress determined that it did not want to be solely dependent upon noncongressional sources for expert analysis on science and technology-related issues. Congress continues to obtain most of its technical information from the executive branch and from the private sector, but it was deemed important to have within the Congress a source of expertise with no programs to promote and no economic interest in a particular congressional decision. With that mandate, OTA examines issues that have a substantial science and technology dimension; that have important implications not only for the present but also for the future; that may involve significant but unintended impacts; that are of national importance as indicated by their potential budgetary or other impacts; and, finally, that are of interest to the Congress.

OTA's capabilities cover all the major applications of technology, including such broad areas as energy, material resources, telecommunications, automation, defense, food, health, environment, and space.

With your permission, Mr. Chairman, I will submit for the record copies of two recent OTA publications. One entitled "Assessment Activities," summarizes our current work; the other is a list of our publications.

[The publications "Assessment Activities" May 1982, OTA-PC-105, and "List of Publications" revised December 1981 OTA-P-58, are available from Office of Technology, Publishing Office, Washington, D.C. 20510, and Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.]

The CHAIRMAN. Without objection, that will be included as part of your testimony.

Dr. GIBBONS. Thank you. The former publication, which we publish several times a year and provide to all Members of Congress, provides a periodically updated summary of all of our work in progress. We feel it is important to provide the committees not only with the products of our work but also a sense of what is in process, as much as a year and a half in advance.

OTA has been able to do its job, because it has built up over time a broad array of capabilities. The 85 to 90 full-time professional staff members embody a variety of disciplines, including physicists, biochemists, engineers, foresters, geologists, medical doctors, lawyers, economists, systems analysts, political scientists, and telecommunications specialists.

Now a word about OTA's methods and procedures, Mr. Chairman.

First, as previously noted, we use a diverse and highly qualified professional staff, and supplement that staff with expertise drawn from wherever it resides in the country, that is, from industry, universities, research firms, foundations, private consultants, and State and Federal government. Typically, about half of our budget for a given project goes to private sector contractors and consultants who are asked to supply basic data, analysis, and advice. These become important inputs to the OTA study, but the actual assessment report is written by our staff. This is important because it assures Congress that OTA itself takes full responsibility for the information that it provides to the Congress. The accumulated knowledge and experience of our staff that has been built during nearly 100 major assessments and numerous briefer analyses constitute a considerable fund of intellectual capital on which we draw for our current work.

When necessary, as with assessments in the area of national security, OTA utilizes classified data from defense and intelligence agencies. On several occasions, when needed, we have also been provided access to proprietary private sector data by industry.

Second, in terms of methods, OTA uses advisory panels that are specifically constituted for each assessment, to provide both expertise and a full range of perspectives on the issues being addressed. The panelists participate by helping define the scope of the study, reviewing the analytical methods being applied, critiquing our draft material, and assisting our staff in obtaining access to needed information—frequently unpublished—wherever it may reside.

In addition, a wide range of external expert reviewers are utilized to critique portions of each draft report before it is submitted to our congressional board. This is a rather extensive process, Mr. Chairman. For example, in 1981 over 2,000 different individuals from all over the country were involved in this process of advice, counsel, and review that I just spoke of.

The Technology Assessment Advisory Council [TAAC] was established by the act that created OTA and is composed of eminent individuals from the private sector, universities, and government. TAAC broadly monitors OTA's work on behalf of the Technology Assessment Board, and it also assists in the review of specific projects and program plans.

A third aspect of our methods and procedures is that an assessment is not undertaken until a request has been carefully evaluated by OTA staff and approved by our congressional board. Project scope and schedules are formulated in consultation with the requesting committees to ensure that they are appropriated.

Fourth, duplication of existing work is avoided at the outset and throughout a project by comprehensive survey of the literature, by consultation with public and private organizations and individuals working on the subject, and by continued overview by the project's Advisory Panel. The NSF and the National Academies of Science and Engineering are especially important sources of information for OTA.

A particular effort is made to coordinate OTA's work with other congressional support agencies, and I am pleased at the progress made in that direction over the 2½ years that I have been director. The effect of such interagency coordination is to not only prevent duplication but also to identify areas where the work of one agency—for instance, OTA—can complement that of another—for example, the General Accounting Office. Where appropriate, the four congressional agencies contribute directly to each others' analyses. For example, CRS regularly assists OTA with legislative history reviews, literature searches, and bibliographic data. CBO has provided OTA with cost analyses and GAO has furnished information from its field operations relevant to ongoing OTA assessments. For its part, OTA has assisted the other agencies with scientific and technical information and analysis.

Fundamental to the ultimate effectiveness of OTA are its major formal assessment projects. These are designed to provide the kind of insight sought by Congress on matters of national concern, representing not just the facts but also the considered judgment of experts when facts aren't clear—and that is more frequently than not the case in controversial issues. The full assessments require considerable time. Typically an OTA full assessment requires about 18 months. This time is required partially because of the practical requirements of analysis and integration of diverse and complex material. Our extensive review process, both internal and external, which is designed to assure correctness, completeness, and quality, and to remove bias, also requires considerable time. These methods and procedures have proven, in my judgment, to be uncommonly effective for OTA.

OTA's reports have generally been found to have enduring value. In a number if instances they have also anticipated events. To the extent that OTA can get a head start by anticipating heightened interest in a technology or an issue and starting advance work on that issue, the Congress is in a better position to deal with it effectively. Frequently, our studies have reached completion over a period of a year and a half or so just as an issue has come to the forefront of national attention. I would like to give you a couple of examples of that, Mr. Chairman.

In November of 1979 OTA finished a project that took considerably in excess of a year to complete. That was on technology and its role in East-West trade; that is, trade between the Western Powers and the Soviet Union, China, and Eastern Europe. This project was completed less than 30 days before Afghanistan was invaded by the Soviets. We were thus able to deliver testimony specific to that issue and associated issues of trade restraints when they arose. I won't say that we want to take credit for anticipating the Soviet invasion, but I was pleased that we were able to undertake our work with sufficient leadtime to be able to say some thoughtful things about that issue when it arose.

A little later on we finished a study on world petroleum availability, in the October 1980, just when a number of issues were coming to the fore about the potential for petroleum production throughout the world during the 1980's and the implications for U.S. energy and foreign policy. In the following spring largely because of your encouragement, Mr. Chairman, we did an analysis of U.S. coal exports and port development. That study now has a newfound importance in the wake of the Soviet gas pipeline to Western Europe and the further interest around the world about having access to U.S. coal.

As a final example, Mr. Chairman, we completed in November (1981) a major study on technology and Soviet energy availability. This project finished after some fourteen months of work just in time, to be utilized extensively in the debate on the Soviet gas pipeline and is still finding extensive use in that regard. This study, we believe, helped clear the air from previously conflicting estimates of the extent to which Soviet energy would be available during the 1980's.

In order to provide information to Congress that is credible and authoritative, OTA's analysis must be comprehensive, thorough and verifiable. That is why we publish detailed assessment reports and supporting documents that only those with a specialized interest in the subject matter read from cover to cover. At the same time we must provide information in a form appropriate to the reader's needs. Consequently we publish a shorter summary of our work intended for people who are interested in the subject but have limited reading time. And we finally force ourselves to reduce the essential results to one page. While this procedure takes considerable time, it is an important part of the process, because we know many of our readers lack the time to read more than one page on that issue, and we need to reach them with accurate information.

Mr. Chairman, concerning OTA's performance, I don't think there is any dispute that issues such as international competitiveness of U.S. industries, or alternative basing modes for MX missiles, or the productivity of American farm and rangeland, the future for synthetic fuels, hazardous waste management, the use and availability of fresh water for agriculture in our west, and other issues, are of critical national importance. Not coincidentally, all of these issues involve major controversies. That is one of the criteria we use before we undertake work. I have been told by a number of observers that anyone who looks at our agenda of work might question our appetite but not our courage. But we believe that the only work OTA should be taking on is work that is controversial, involves potentially large costs, and encompasses major unresolved issues.

In terms of our productivity and quality, OTA delivers about 20 formal assessments each year. The reports are substantial documents; they average about 300 printed pages with several hundred to more than a thousand pages of technical appendixes. The summaries of these assessments are prepared by the same team that carries out the detailed study in order to convey the findings accurately and to catch the essential points of the analysis. In addition to these formal reports, typically 35 to 45 formal subsidiary publications, in the form, for example, of technical memoranda, are produced annually. These average about 50 pages in length.

We testify an average of once a week—this is the third time this week OTA has testified. In addition, the Office conducts many briefings for congressional staffs. At least 12 different Senate and 10 different House committees were recipients of one or another OTA product during 1981. With a staff of our size, Mr. Chairman, it's little wonder that some committees don't hear from us very often. We have less than one professional employee, per subcommittee of the Congress.

The numbers that indicate the frequency at which we are called on to testify, or the products we deliver, or the briefings we make provide some measure of our productivity, Mr. Chairman, but there is another important ingredient, and that is quality. To assure the quality of our work we depend on the expertise of our staff and on an extensive formal review process involving not only our internal reviews and those of the project advisory panel, but numerous outside reviewers, experts on the outside.

The result has been a remarkable record of nearly a decade of operation free from any serious factual or analytical errors in our products, or sustained criticism of bias in our reports.

In my formal testimony, I mention some indicators of quality. One indicator is the use of OTA studies as texts in major universities; a second is the volume of GPO sales of OTA reports; third is the commercial reprints of OTA reports—some 31 assessments have now been reprinted by the commercial press, 8 within the last 6 months; and, in fact, several of these have been translated and printed overseas. Fourth is the responsiveness of very distinguished people when we ask them to give us advice or to serve on advisory panels or to review documents. Clearly, their willingness to participate indicates they feel it is worth their time. A final indicator is the normal feedback one obtains from peer review, whether it be within the Congress or from professionals outside.

Now, in terms of usefulness, we have developed a variety of formats and distribution strategies for OTA's products. I know from your questions earlier this morning that you are concerned about the extent to which OTA's work actually reaches the appropriate congressional Members and staff. These products are designed to try to make the results of OTA's analyses as useful as possible for Members. The full-length assessment report is provided to the requesting committees and to any other committee or Member that asks for it. The summaries are published separately and are automatically provided to all Members, staff directors, and minority counsel at the time the report is released to the committee or by the committee. Publication briefs—one page summaries—are provided to the same individuals. Copies of the report are made available to the public through the Government Printing Office. Technical appendices which provide the backup information and supplemental material are normally made available in much more limited numbers to interested congressional staff; most are also sent to the NTIS of the Department of Commerce for public availability.

In addition to the full assessments, OTA publishes technical memoranda, staff papers, and background papers to meet committee needs for timely and more focused analysis of specific legislative issues. I believe that these written products, along with testimony to committees, briefings and phone responses, constitute a necessarily diverse range of products and responses to meet the needs of the Congress for OTA's particular resources.

Finally, current congressional awareness of our products and activities and plans is assisted by the quarterly issuance of the assessment activities and the list of publications.

Mr. Chairman, our responsibility is obviously not to try to tell Members of Congress how to legislate, but rather to provide information that will enable Members to make more informed judgments on issues related to science and technology. OTA does not recommend particular courses of action; rather it seeks to identify the issues, to illuminate viable policy alternatives, and to spell out the consequences that could attend the various choices. Consequently, OTA's most valuable contribution is to help Congress establish the terms of reference, to separate the important from the less important, and to distinguish what is feasible and factual from what is impractical and incorrect. If OTA's analyses become part of the language of discourse in the Congress and at senior levels elsewhere in the Government as major issues are addressed, then OTA has done its job. By this key criterion I think a number of OTA studies have had a substantial impact. My testimony provides some examples.

The exact extent of policy impact is notoriously difficult to measure or judge. A large number of factors and players influence such national policy decisions as those concerning the basing of the MX missile or the management of nuclear waste. With rare exceptions, it is impossible and probably not even productive to try to identify with any precision the influence of any one factor, such as OTA's work. Since OTA provides advice but does not make decisions, it would be inappropriate for us to claim credit for any particular policy actions.

Nevertheless, it is clear that OTA findings have influenced Federal policy and program decisions. Examples include OTA's work on shale oil, MX basing, cost-effectiveness analysis of medical technologies, pneumococcal vaccine, and other subjects mentioned in my written text.

OTA assessments, in addition, have sometimes identified where there might be substantial potential savings in Federal expenditures. Examples include our work on ocean thermal energy conversion, shale oil technologies, ocean margin drilling, MX basing, energy conservation, advanced supersonic transports, and solar power satellites. These have indicated potential savings ranging from millions to tens of billions of dollars.

There are a number of reports that will be released in the near future that we anticipate will have considerable impact. These include assessments of the air traffic control system, competitiveness in the electronics industry, nuclear waste management, nonnuclear industrial hazardous waste, synthetic fuels, and other examples given in my written testimony.

In conclusion, OTA is an agency that performs a critical role in helping Congress cope with some of the most vexing problems facing this Nation. It is an agency with a proven record of performance and an international reputation for quality work. I was proud to come to OTA 2½ years ago, but I am even prouder to be here now.

There is no reason to expect that the pace of scientific and technological change is going to slow or that the issues before the Congress are going to become less difficult. The need for OTA's kind of expertise and analysis can only grow, as I see it, as we enter the last two decades of the 20th century in an increasingly challenging and dangerous world. I am convinced, Mr. Chairman, that OTA will be an effective instrument for the Congress in these years ahead.

Thank you.

[The prepared statement of Dr. Gibbons follows:]

PREPARED STATEMENT OF DR. JOHN H. GIBBONS, DIRECTOR, OFFICE OF TECHNOLOGY ASSESSMENT

Mr. Chairman, I am pleased to speak to this Committee on the occasion of the first OTA Oversight hearings in the Senate.

If I may, Mr. Chairman, let me begin on a personal note. In the Spring of 1979, I uprooted my family and left a pleasant job situation in Tennessee to assume the directorship of OTA because of my conviction that OTA performs an essential service for Congress and the nation. After nearly three years on the job, I have found no reason to modify that conviction; indeed, my earlier feelings have been intensified. OTA is a unique resource for helping Congressional Committees deal with some of the most important and perplexing problems on the public agenda.

OTA's Mission.—Technology is critical to our national future. Increased productivity and consequent economic vitality must derive in large measure from technological innovation. Technology is also needed to control the potential negative consequences of such technology-driven growth, including environmental damage and job displacement. If national defense capabilities are to be significantly upgraded, technology will play a central role. The promise of better health care rests, in large part, on improvements in medical and health care delivery technologies. In short, we live in a high technology era.

The Act and the legislative history of OTA indicate that the Office was established as Congress' own source and center of nonpartisan technical expertise and analysis. OTA is responsible for providing Congress with the best possible synthesis of national wisdom on issues it faces involving science and technology.

OTA, with its broad technical expertise, serves as a shared staff to the Committees of the Senate and House. Many of OTA's studies are carried out in response to requests from more than one Committee because the issues they contain lie within the jurisdiction of several Committees. For example, the requesters for Technologies for Sustaining Tropical Forest Resources include the House Committee on Foreign Affairs and the Senate Committee on Energy and Natural Resources, with endorsements from the House Committee on Interior and Insular Affairs (Subcommittee on Insular Affairs) and the Senate Committee on Environmental and Public Works (Subcommittee on Environmental Pollution). For the Commercial Development of Biotechnology, and also for High-Level Radioactive Waste Management and Disposal, requesters include the Senate Committee on Commerce, Science, and Transportation and the House Committee on Science and Technology. A recently-completed report on Technology and Soviet Energy Availability was carried out for the Senate Committee on Banking, Housing, and Urban Affairs, the House Committee on Foreign Affairs, and the House Committee on Science and Technology.

OTA was created because Congress determined that it did not want to be solely dependent upon non-Congressional sources for expert analysis on science and technology-related issues. Congress continues to obtain most of its technical information from the Executive Branch and from private industry, but it was deemed important to have within the Congress a source of expertise with no programs to advance and with no economic interest in a particular Congressional decision. With that mandate, OTA examines complex issues that have a substantial science and technology dimension; that have important implications not only for the present, but the future; that may involve significant, but unintended, impacts; that are of national importance as indicated by their potential budgetary or other impacts; and that are of interest to the Congress. It is a demanding task to produce authoritative, objective, and timely reports on such issues.

OTA's Capabilities.—OTA covers all the major applications of technology including energy, material resources, telecommunications, automation, defense, food, health, environmental, and space. Its projects range from cytogenetic screening in the workplace to the command, control, and communications systems of U.S. strategic forces.

Mr. Chairman, with your permission, I will submit for the record copies of two recent OTA publications entitled Assessment Activities and List of Publications. The former provides Congress with a periodically updated summary of work in process, its projected completion date, and a telephone contact at OTA. The latter lists all OTA publications and indicates how copies can be obtained. Together, they provide an up-to-date catalogue of OTA's current and completed work.

OTA has been able to do its job because it has built up over time a broad array of capabilities. The 85–90 full-time professional staff include physicists, biochemists, engineers, geologists, foresters, medical doctors, lawyers, economists, systems analysts, political scientists, and telecommunication specialists.

Since its inception, OTA has produced nearly one hundred major assessments and many briefer analyses. These products, in conjunction with the accumulated knowledge and experience of staff, constitute a considerable fund of intellectual capital on which OTA draws for its current work. In addition, the Office has electronic assess to over 200 bibliographic and statistical data bases in addition to the inventory of The Library of Congress.

Finally, and probably most important, in the course of carrying out an assessment, OTA typically develops, identifies and draws upon an extensive national network of experts in the corporate, academic, and public sectors. Each year about 2000 different individuals from all over the U.S. are involved with OTA in this process.

After a study is complete, these networks remain helpful and available as a source of information for subsequent use on behalf of Congressional Committees. In short, Congress, has in OTA a resource of unique scope, depth and flexibility.

OTA Methods and Procedures.—OTA's mandate is to produce assessments that are: (1) accurate and authoritative; (2) comprehensive and unbiased; and (3) relevant and timely in view of Congressional needs for the current agenda or for foresight. It must also draw upon and complement, but not duplicate, existing work. OTA has developed and routinely utilizes a variety of methods and procedures designed to produce studies that meet these criteria.

First, as previously noted, OTA utilizes a diverse, highly qualified professional staff and supplements their capabilities with expertise drawn from wherever it resides—industry, the universities, research firms, foundations, private consultants and the government. Typically, half of the budget of a project goes for private sector contractors and consultants who are asked to supply basic data, analysis, and advice. These become inputs to the OTA study, but the actual assessment report is written by OTA staff. This is important because it assures Congress that OTA itself takes full responsibility for the information it conveys to the Congress. When necessary, as with assessments in the area of national defense, OTA utilizes classified data from the defense and intelligence communities. On several occasions, when needed, OTA has also been provided access to proprietary data through industry cooperation.

Second, OTA uses advisory panels specifically constituted for each assessment to provide both expertise and a full range of perspectives on the issues. The panelists participate in defining the scope of the study, review analysis methods, critique drafts, and assist the OTA staff in obtaining access to needed information. In addition, a wide range of external expert reviewers are utilized to critique portions of draft reports before they are submitted to OTA's Congressional Board.

The Technology Assessment Advisory Council (TAAC) was established by the Act that created OTA and is composed of eminent individuals from industry, university, and government. TAAC broadly monitors OTA's work on behalf of the Technology Assessment Board (TAB) and also assists in review of specific projects and program plans.

Third, OTA rarely undertakes an assessment unless there is a request from one or more Committee of the Congress. Even in those few instances where an OTA study has been undertaken at the initiative of the TAB or of the Director, an effort is made to identify and consult periodically with interested Committees to assure the relevance of the work to the Committees' needs. An assessment is not undertaken until it has been carefully designed and reviewed by OTA staff and approved by OTA's Congressional Board. Project scope and schedules are formulated in consultation with Committees to assure relevance and timeliness.

Fourth, duplication of existing work is avoided at the outset and throughout a project by comprehensive review and monitoring of the professional literature, by consultation with public and private organizations and individuals working on the subject, and continued overview by the project's Advisory Panel. The National Science Foundation (NSF) and the National Academies of Science and Engineering are especially important sources of information for OTA. Accordingly, OTA and these agencies have provided for periodic exchanges on work completed and new work contemplated for the future. In the interactions between NSF and OTA, the agenda includes both topical issues in technology and methodological approaches to the process of technology assessment.

A particular effort is made to coordinate OTA's work with that of the other Congressional Support Agencies (CBO, CRS, and GAO). A computerized Research Notification System provides current and cumulative information on all studies underway or recently completed by these four agencies. Written notification is supplemented by periodic meetings of senior staff and heads of the support agencies. In addition, project staffs from the agencies meet as required to coordinate specific ongoing activities. The effect of OTA's procedures and methods is to not only avoid duplication but also to identify areas where the work of one agency complements that of another. Where appropriate, the Congressional agencies contribute directly to each other's analyses. For example, in one of its recent assessments, OTA drew upon cost analysis done by CBO. In another, GAO furnished helpful data from its field operations. At present, OTA has agreed to provide technical assistance to a GAO analysis of the Micronesian Compact of the Free Association, and the same two agencies are considering a coordinated approach to a study of workplace health and safety. OTA also refers requests to CRS and GAO as appropriate.

Fundamental to the ultimate effectiveness of OTA are the formal assessment projects. About thirty are in process at a given time. I have provided as an attachment for the record a current summary of Assessment Activities. These are designed to provide the kind of thoughtful and comprehensive insight sought by Congress on matters of national concern, representing not just the facts but also the considered judgment of experts when facts aren't clear. The assessments require considerable time—typically 10 to 20 months—because of the practical requirements of the analysis and integration of diverse and complex material. OTA's extensive review process, designed to assure correctness, completeness, and to remove any bias, also requires considerable time. Some technical tasks can be performed simultaneously but the key tasks of resolution of diverse and often conflicting information, policy analysis, writing, and review must be done sequentially.

OTA's reports have generally been found to have enduring value. To the extent that OTA can get a head start by anticipating heightened interest in a technology or issue and starting advance work on it, the Congress is even better served. Frequently, OTA studies have reached completion just as an issue has come to the forefront of national attention. For example, that OTA's work on Technology and Soviet Energy Availability, which required 14 months, was completed and delivered to Congress in time to contribute to the international debate over the Soviet gas pipeline to Western Europe.

The conduct of major formal assessments by OTA both fosters and sustains a broad level of expertise within OTA. This provides the backdrop and resource base on which OTA can draw for additional special responses to specific Congressional needs. Because the timing of Committee needs cannot be totally predicted, OTA provides, on request, briefings and testimony on issues based upon its special expertise derived from past assessments or drawn from ongoing projects.

OTA's procedures for assuring accuracy, balance, relevance, and usefulness are the product of several years experience. The essense of the OTA approach is the maintenance of a relatively small but highly qualified permanent professional staff to provide continuity and a learning curve from one assessment to the next, while temporary appointments, consultants, and contractors are used as a flexible supplementary source of particular expertise appropriate to whatever issue is being addressed. In this way, the rigidities inevitable in a large bureaucracy are avoided. At the same time, the permanent staff provides institutional continuity while temporary employees, consultants, contractors, and advisory panels are used to tailor OTA's resources to a particular project and to exploit national wisdom. Experience has proven this to be an uncommonly effective organizational strategy. OTA recruits its professional staff with an eye toward maintaining maximum flexibility and diversity—as well as expertise. Similarly, its issue-oriented management structure is modified over time as issue priorities in Congress change.

OTA Performance.—Let me suggest that an evaluation of OTA's performance ultimately rests on the answer to four basic questions: (1) Does OTA address important issues—important now and in the years ahead to Congress and to the country? (2) Is it reliable, authoritative, and balanced? (3) Is it useful to the Congress? (4) Does OTA work have an impact on national policy?

IMPORTANCE OF ISSUES

There is surely no dispute that issues such as the international competitiveness of U.S. industries, MX missile basing, the productivity of American farm and rangeland, the future for synthetic fuels, hazardous waste management, the use and availability of fresh water for agriculture, and the impact of computer and telecommunication techology are of critical national importance. Not coincidentally, they all involve major controversies. I have been told by a number of observers that anyone who looks at OTA's agenda of work might question its appetite, but not its courage!

PRODUCTIVITY AND QUALITY

OTA delivers an average of 15-20 formal assessments per year. The formal reports are substantial documents averaging about 300 printed pages with anywhere from several hundred to several thousand pages of technical appendices. Careful summaries (including one-page executive summaries) of these assessments are prepared by the same team that carries out the study in order to convey the essential results. In addition, typically 35-45 formal, subsidiary publications (primarily in the form of Technical Memoranda, Background Papers, and Testimony) are produced annually as required. These average about 50 pages in length.

OTA testifies an average of once a week at Committee hearings when Congress is in session. In addition, the Office conducts many briefings for Committee staffs. At least 12 different Senate and 10 different House Committees were recipients of one or another OTA product during 1981. Finally, there is a vast amount of informal communication with Members and Committees concerning subjects of existing and past assessments in the form of informal discussions (estimated at 100-200 per-week).

These numbers provide a measure of productivity, but there is another important ingredient—quality. To assure quality, OTA depends on the expertise of its staff and upon an extensive formal review process involving OTA management and staff, the project advisory panel and numerous outside experts. The result has been a record of nearly 10 years of operation free from any serious factual or analytical error, or sustainable criticism of bias in OTA reports.

The quality of OTA's work is suggested indirectly but persuasively by the fact that:

(1) Numerous OTA assessment reports are now used as textbooks in major universities.

(2) GPO sales of OTA reports are running at an average of $200,000 per year (OTA makes available only very limited numbers of its full reports to individuals outside Congress without charge—normally only to those who have made significant

contributions to the study). Few, if any government agencies test the demand for their product in the private marketplace to a comparable degree.

(3) Nearly all of OTA's current output of full reports is being reprinted by commericial presses, and in several instances the reports have been translated and printed overseas.

(4) OTA is able to attract some of the most distinguished individuals in the country—including Nobel Laureates, university presidents, senior corporate executives, former senior government officials, foundation presidents, and a diverse group of internationally recognized individuals in various fields—to serve on project advisory panels.

(5) OTA reports have been widely praised for their quality by informed observers. For example, the latest Congressional Staff Journal published by this Committee comments on OTA's assessment of Computer-Based National Information Systems as follows:

"In many respects, this is a model study: candid and truly critical in its substantive aspects, nicely organized, well designed and printed, accessible to nonexperts, and supported by good bibliographical notes integrated into the main text."

OTA has developed a variety of formats and distribution strategies for its products. They are designed to make the results of our analyses as useful as possible for Members and staff of Congress. The full length assessment report is provided to the requesting Committees and to any other Committees or Members that ask for it. Summaries (15–30 pages) are published separately and are provided to all Members, Staff Directors, and Minority Counsels. Publication Briefs (one page executive summaries) are provided to the same individuals. Copies of the Report are made available to the public through the Government Printing Office. Technical appendices, which provide backup and supplemental information are normally made available in very limited numbers to interested Congressional staff or the general public through microfilm from NTIS.

In addition to the full assessments, OTA, as previously noted, publishes Technical Memoranda, Staff Papers, and Background Papers to meet Committee needs for timely, more focused analysis of specific legislative issues. I believe that these various written products, along with testimony to Committee, briefings, and phone responses constitute a necessary diverse range of products to meet the manifold needs of Congress.

The Congressional awareness of OTA's products, activities, and plans is assisted by the quarterly issuance of the Assessment Activities and List of Publications booklets.

IMPACT

OTA's responsibility is not to try to tell Members of Congress how to legislate, but rather to provide information that will enable Members to make more informed judgments on science and technology issues. OTA does not recommend particular courses of action; rather it seeks to identify the issues, illuminate viable policy alternatives, and spell out the consequences that will attend the various choices. Consequently, OTA's most valuable contribution is to help Congress establish the terms of reference, separate the important from the trivial, and distinguish what is feasible and factual from what is impractical and incorrect. If OTA's analyses become part of the language of discourse in the Congress and at senior levels elsewhere in the Government as major issues are addressed, OTA has done its job. By this key criterion numerous OTA studies have had a substantial impact. A few recent examples include: OTA's work on Soviet energy, cancer risks from the environment, patent term restoration, atmospheric alterations, contaminants in food, coal exports, the World Administrative Radio Conference, solar energy, solar power satellites, standardization of nuclear reactors, direct uses of coal, coal slurry pipelines, nuclear proliferation, the effects of nuclear war, enhanced oil recovery, and the competitiveness of U.S. steel, automobile, and electronics industries in international markets.

The extent of more direct policy impact is notoriously difficult to measure or judge. A large number of factors and players influence such major national policy decisions as those concerning the basing of the MX missile or the management of nuclear waste. With rare exceptions, it is impossible and probably not even productive to identify with any precision the influence of any one factor. Since OTA provides advice but does not make decisions it would be inappropriate for that agency to claim credit for policy actions.

Nevertheless, it is clear that OTA findings have influenced Federal policies and programs. Examples include OTA reports on shale oil technologies, MX missile basing, cost-effectiveness analysis of medical technologies, pneumococcal vaccine, compensation for vaccine-related injuries, food and agricultural research, food information systems, agent orange, taggants in explosives, energy from biomass, enhanced oil recovery, energy conservation, and Federal coal leasing.

OTA assessments, in addition, have sometimes analyzed where there might be substantial potential savings in Federal expenditures. Examples include OTA studies of ocean thermal energy conversion, shale oil technologies, ocean margin drilling, 200-mile fisheries zone, MX basing, energy conservation, advanced supersonic transports, and solar power satellites. These have indicated potential savings ranging from millions to tens of billions of dollars. OTA has also made numerous suggestions for improvements in existing programs through more effective application of technology.

In addition, there are a number of reports that will be released in the near future that we anticipate will have considerable impact. These include assessments of the air traffic control system, the National Crime Information Center, U.S. civilian space policy, computer modeling of global systems, electronic message systems, commuter air service, the electronics industry, nuclear waste management, cropland productivity, the biotechnology industry, water availability for arid lands, nonnuclear industrial hazardous waste, U.S. natural gas availability synthetic fuels, and strategic command, control, and communications systems.

Congress is asked to appropriate money for projects and programs utilizing increasingly expensive technologies. The day is long since past, if it ever existed, that this nation could afford multimillion or multibillion dollar mistakes. Indeed, we are increasingly in the situation of choosing not simply the promising options from the unpromising ones, but selecting only one or two from among a group of options, all of which are promising. The acquisition and exercise of knowledge is the most reliable way to avoid mistakes and to minimize cost.

Federal policy is also influenced by the public's awareness of issues. OTA assessments, available from GPO commercial publishers, are now widely used by universities, industry, and nonprofit citizens and professional groups. The print media now regularly report on OTA work.

Further evidence of the growing stature of the Office is the widespread use by state and local governments of OTA work and the attention paid to it by foreign governments, notably in Europe. In 1981, hardly a week passed without a visit to OTA by a senior official or delegation from one of the European countries. Government institutions analogous to OTA have been established in France and Great Britain and are under active consideration in Germany, Sweden, Mexico and elsewhere.

In conclusion, OTA is an agency that performs a critical role in helping Congress cope with some of the most vexing problems facing the nation. It is an agency with a proven record of performance and an international reputation. There is no reason to expect the pace of scientific and technological change to slow or the issues before Congress to become less difficult. The need for OTA's kind of expertise and analysis can only grow as we enter the last two decades of the twentieth century in an increasingly challenging and dangerous world. I am convinced that OTA will be an effective instrument for the Congress in the years ahead.

Mr. Chairman, thank you for the opportunity to review OTA with you. I will be pleased to answer any questions.

Congress of the United States,
Office of Technology Assessment,
Washington, D.C., February 16, 1982.

Hon. Charles McC. Mathias, Jr.,
Chairman, Committee on Rules and Administration, U.S. Senate, Washington, D.C.

Dear Mr. Chairman: This is to acknowledge your letter of February 8, 1982, requesting written responses to additional questions on the operations of OTA. The responses to your questions are enclosed.

I wish to thank you for the opportunity to appear before your Committee and look forward to the results of your Committee's review of OTA.

Please let me know if I can furnish any additional information.

Sincerely,

John H. Gibbons.

Enclosure.

Question 1. I am interested in the issue of OTA providing Congress with independent, objective analysis—analysis that some say wouldn't be otherwise obtainable by the Congress. How does the work of OTA differ from that of the National Academies, non-profit think tanks, commercial research firms, and academic groups?

Answer. OTA's work generally differs from these other groups in the following ways: procedure; content, and extent of interactions with Congress. In each of these areas there are some similarities with other groups but also significant differences. For example, commercial research firms do not draw on a national network of advisers and consultants, as does OTA. The National Academies rely heavily on outside panels to actually write their reports. Academy reports must meet the approval of the panels (or contain minority positions). OTA gives more attention to analysis of policy options than is customary for other groups. University groups, non-profit think tanks, and the National Academies do not tailor their analyses to Congressional Committee needs and schedules, as must OTA. OTA, because of its direct relationship to Congress, interacts more frequently, in greater depth, and in a greater variety of ways with Committees. This communication occurs in initiation of a project, during the course of the work, during the process of delivery of the formal report to Congress, and in the conduct of follow-on activities such as briefings or testimony.

Procedure.—(1) To conduct its assessments, OTA utilizes small, in-house multidisciplinary groups of analysts especially chosen for each project. These OTA staff members using input from the advisory panel and contractors, reviewers, and interested Committee staff, perform the analysis, write the report, and deliver the information to Congress.

(2) Expert advisory panels are carefully constructed by OTA staff to bring together the principal parties of direct and indirect interest to the issue. They actively participate in the planning of the project as well as in critiquing drafts of the report. Members are drawn from diverse sources in the private and non-federal government sectors. Observers and liaison persons are also invited from relevant federal agencies. This helps guarantee that the reports complement but do not duplicate other work.

(3) The degree of internal and external review of draft material is very extensive. This is done to doubly ensure accuracy, comprehensiveness, and objectivity.

(4) Contractors and temporary staff are used to supplement OTA staff in carrying out specific assessment tasks. This procedure allows OTA great flexibility in assembling appropriate expertise, yet retains for OTA staff the critical analysis, final synthesis, writing, and delivery of the work.

Content.—(1) OTA studies synthesize all existing information (including both reports and unpublished work-in-process of the Academies of Science and Engineering, universities, private industry, federal agencies, and OTA's sister agencies). These data include not only the relevant science and technology material, but also information related to economic, environmental, governmental, and social implications.

(2) OTA's analyses strive to identify the facts, and—where facts aren't available—areas of expert consensus as well as areas where no strong consensus can be identified among the parties of interest. Specific policy actions are not recommended but much attention is paid to policy analysis, resulting in a presentation of policy options and alternatives.

(3) OTA's publications are carefully documented (e.g. sources or derivation of numbers are traceable). Reports are written in non-technical English, avoiding jargon, in order to be understandable by policymakers. In addition to providing the fully-documented report and back-up material to relevant Committees, OTA provides summaries (10–14 pages) and one-page publication briefs to all Members.

(4) When required, OTA can have access to classified information. It is thus able to ensure the accuracy of its broadly accessible unclassified reports, as well as prepare classified documents when necessary.

Extent of Interactions with Congress.—OTA's projects, normally performed in response to requests from one or more committees, are paced to allow continuous feedback between the committees and the OTA project staff. This enables OTA to make timely responses to information needs of the committees during and after completion of the work. In many instances, interim products (e.g., briefings, testimony, background papers) are provided long before formal completion of the work. In some instances the project scope is shifted to accommodate changing needs of the Committee. After delivery of the formal report, OTA frequently provides further specific information, drawn from the assessment, that is needed by Congress.

In short, this combination of procedures, content, and Congressional interaction is unique to OTA.

Question 2a Which Committees in the Senate have requested studies? How many on the part of each Senate Committee?

Answer. Thirteen Senate Committees have requested studies during the 96th and 97th Congress through December 31, 1981. The Committees and the number of requests made by each are as follows:

Agriculture, Nutrition, and Forestry	3
Appropriations	7
Banking, Housing, and Urban Affairs	1
Budget	1
Commerce, Science, and Transportation	16
Energy and Natural Resources	7
Environment and Public Works	7
Finance	2
Foreign Relations	5
Governmental Affairs	4
Judiciary	3
Labor and Human Resources	6
Veterans' Affairs	2
Total requests	64

Question 2b. In your opinion, would these Committees be willing to be directly billed for the costs of these studies?

Answer. I do not know what different Committees would think about direct billing, but I do know that requests by Committees are made with significant thought on their part—as well as OTA's—about the resources (including time) required and the scope of the work requested. Since OTA typically undertakes assessments on issues which transcend the interests of one Committee, this means for a given assessment we usually deal with and deliver to a multiplicity of Committees. Indeed, every Member of Congress can gain some access to OTA reports and expertise. These facts make the notion of direct billing very complicated.

Furthermore, OTA attempts to incorporate into its assessments sufficient breadth to view the immediate issue(s) in a way that helps keep the important longer-term and less-direct impacts in mind. Such an orientation is of great potential value to Congress but might not appear to be of sufficient urgency to an individual Committee that it would justify being billed for the work. Direct billing might mean that the Committee would want to control the use and availability of the product(s) or look to OTA to support a particular political position. The resulting pressures could jeopardize OTA's objectivity and lack of ideological bias. OTA does assessments mostly at the request of Committees, but it must be beholden to no one, not even the requesting Committees.

Finally, OTA and its Board need to have flexibility in accepting requests for studies and in rescheduling to accommodate changing Committee needs. This is necessary because OTA has no reserve capacity. When an additional work assignment or change in scope occurs, it must either await the completion of current work or some current work must be rescheduled. Direct billing would prejudice the ability of OTA's management and Board to optimize the agency's response to such events in a way that provides maximum benefit to Congress. It is worth remembering that OTA was created as a support agency to the Congress. If it can only function by depleting other Congressional resources, its usefulness could be severely compromised.

Question 2c. If so, could these Committees contract with an independent agency like NAS or NAE to perform or subcontract such studies?

Answer. Committees can, and do, contract with agencies such as NAS and NAE. These studies are usually more limited and focussed on specific technical issues than are those undertaken at OTA. Furthermore, OTA gives relatively more attention to policy analysis in its studies. OTA is probably better equipped than the National Academies to tailor its analyses and the delivery of its work to shifting committee schedules and needs. As part of Congress, the extent of informal interaction between OTA staff and congressional staff means that OTA products are more relevant for congressional needs.

Question 2d. Could CRS' SPRD contract for such studies?

Answer. The Science Policy Research Division of CRS can contract work. The critical point is not one of contracting authority but rather the process involved in scoping a study, defining the tasks, carrying out the tasks (which involves contracting), critically analyzing and integrating the results, writing and "delivering" the products. OTA's procedures for this flow of work, developed over nearly a decade, is quite different from its sister agencies, as well as NAS and others. The extent and nature of contracting necessary at OTA could not be managed by the SPR Division without major expansion of staff.

Question 3a. What does OTA's public publishing program have to do with its mission for the Congress?

Answer. OTA does not publish in the first instance for the public—it publishes first and foremost for Congress. After printing at GPO, OTA reports are delivered to

Congress. OTA uses modern cost-saving electronic methods to transform typewritten material, figures, graphs, and tables into type-set, readable publications. Also, in order to meet Congressional need for different levels of detail on an issue, OTA separately prints summaries of full reports. Copies of the summary are sent to all Members and staff directors, but full reports are sent only to Members of requesting Committees or those who specifically request them.

After they have been delivered to Congress, copies are also sent to some key individuals outside as well as in government who provide assistance to OTA. Unclassified OTA publications are made available for public purchase direct from GPO and NTIS. Report summaries are provided on request by OTA free of charge to both Congress and the public. Because of the considerable interest in OTA's publications in the university, industry, and public interest communities, GPO sales have been large and commercial publishers (at their own initiative) usually republish OTA reports. One reason for this is that OTA addresses enduring issues, so the reports tend to have a long effective life.

OTA's statute explicitly addresses the issue of making information available to both Congressional Committees and to the public (Section 3e). Because OTA constantly taps the expertise of its technical peers around the country, it is in Congress' interest for OTA to keep those individuals informed about current activities and new publications.

Question 3b. How does OTA's involvement with business, industry, and the academic community benefit the Congress?

Answer. The extensive involvement of OTA with business, industry, and academia (in addition to its sister agencies and the Executive Branch) enables it to take fullest advantage of all relevant knowledge and information. Without this access, there is no way that OTA could work effectively on such a broad array of issues in technology and policy. Furthermore, because science and technology are evolving so rapidly, OTA's wide-reaching interactions with the private sector are essential to assure that it stays abreast of the latest developments and that it does not duplicate the work of others.

Congress set up OTA to serve as a bridge between itself and the scientific and technological community. Because of OTA's procedures in dealing with people from these areas, we are able to get information and insight that cannot be obtained in the hearing process. There are three reasons for this. First, these groups are always represented on our advisory panels and workshops. These meetings bring about an exchange of views among the different, often competing, interest groups that allow OTA not only to hear these views but to understand why they are held, in other words what assumptions are made and what data are used by the various communities in arriving at these views. The second point concerns trust. Because we take great pains to listen to these advisors, and to carefully, fairly and accurately incorporate their views in our analyses, we are usually able to get frank and detailed comments and expressions from them. Finally, the advisory panel is a continuing body in that it exists for the life of the project. Therefore, OTA can obtain their views on many different aspects of the assessment, determine how these may change over time as the study progresses, and possibly gain new insights from these groups as we uncover different issues. All these points allow a much deeper and more comprehensive analysis of issues.

Question 4a. How has the organizational structure of OTA changed since you became Director?

Answer. The organizational structure has been somewhat modified to increase flexibility and productivity. Changes include the following:

(1) As a cost-saving measure, the Deputy Director position was not filled when it became vacant in October 1980.

(2) An Operations Division was formed to improve the quality, coherence, and responsiveness of various OTA administrative and support services that perviously reported individually to the Director.

(3) Within the three professional line divisions, several programs were phased out and others were re-oriented, reflecting the changing nature of issues faced by Congress.

(4) Arrangements with OTA's Congressional Technology Assessment Board (TAB) have been made so that the Director is given more flexibility for operating the agency, while simultaneously providing more extensive and systematic information to the Board on OTA's activities. Similarly, the Technology Assessment Advisory Council (TAAC) now meets semiannually instead of monthly and TAAC's Chairman formally communicates the results of the meetings to the Chairman of TAB.

Question 4b. Has this new structure improved interdivisional communication?

Answer. Interdivisional communications has improved, but not as a direct result of organizational changes. Activities initiated to specifically enhance internal communication include the following:

Weekly meetings of senior administrative management (Director, Assistant Directors, Operations Manager, Administrative Officer, and Congressional and Institutional Relations Director).

Monthly meeting of all senior management staff on a variety of subjects of common concern.

Occassional meetings of the entire staff, normally called by the Director to discuss important issues to the agency, such as a briefing on an Oversight or Appropriations hearing.

Regular separate meetings of Division staff.

Project Screening Committee to assure appropriate scope and use of OTA expertise in new projects through review and concurrence of OTA's Director and the Assistant Directors prior to preparation and submission to TAB of a proposed new assessment.

Semi-monthly publication of "FOCUS," an agency-wide brief that provides information on library acquisitions, new OTA reports, testimony and other activities, new employees, and other items of OTA-wide interest.

Weekly lunchtime seminars on topics of common interest to OTA assessment staff.

Special seminars are also given in which the provisional or final results of an assessment are presented and discussed.

Interprogram and interdivisional temporary "loans" of personnel are encouraged. Expertise is informally and continually shared across divisional lines. Interprogram and interdivisional workshops in specific assessments are increasing. Circulation of proposals, staff papers, and assessment drafts for comment is encouraged.

Correspondence and document control procedures have been established to ensure that the senior staff are kept uniformly aware of key material, especially that related to Congressional requests.

Question 5a. How would you respond to assertions that there is too much staff turnover by OTA, contractor, and advisory panel staff during individual technology assessments?

Answer. Because of its small size and shifting focus of work, OTA must resort to employment, contracting, and advisory policies that are *designed* for turnover. Thus, many appointments are for terms that range from less than one year to two years (i.e., the lifetime of an assessment). However, key managers, senior analytical staff, and administrative personnel do not turn over nearly as rapidly and thereby help provide the requisite institutional learning and memory.

OTA does not provide extensive opportunities for upward mobility because of its small permanent senior staff and the nature of its work. Furthermore, it seeks and is able to attract very capable young professionals with expertise and advanced training in specific technological areas. Since such people are in constant demand, OTA accepts the fact that many of its employees will move on to more senior jobs. Frequently an assessment team will largely disband shortly following completion of a study. This is because some have planned to be at OTA only for that project, others are attracted away, and the remainder are reassigned to new products. Finally, many professionals come to OTA with the idea of only staying a few years because of the intensity of the job and to gain exposure to the process of Congress.

OTA has experienced very little turnover of contractors and advisory panel members during the course of an assessment. However, if contractors or employees do not do satisfactory work, they are replaced.

Question 5b. Is the length of time taken to complete certain technology assessments responsible for this staff turnover?

Answer. The relationship between staff turnover and the time required to complete an assessment is complex. In some instances the schedule of an assessment must be modified significantly because of the unanticipated loss of a single individual. In a few instances, an assessment project has not gone well and sometimes that fact can be traced to inadequate performance of staff and/or contractors. In those cases, OTA has had to replace some or all of the team with consequent delays in completion of the work. I know of no instances in which key people have left a project voluntarily because the assessment was requiring too much time to complete.

Question 6. Does OTA's agenda of work reflect the National Science Foundation's new list of science and technology issues likely to have relatively near-term effects on American society?

Answer. In its "Five Year Outlook on Science and Technology: 1981," the NSF lists seven areas: (1) Robotics and Artificial Intelligence; (2) Materials Sciences; (3)

The Space Shuttle; (4) Remote Sensing Satellites; (5) Recombinant DNA; (6) Information Services; and (7) Electronics Technologies.

OTA's current agenda of work (see Assessment Activities, previously cited) shows a high correlation between OTA work that is ongoing or recently completed and the NSF list. In connection with 1, 6, and 7 (above) directly-relevant OTA studies include: Workshop on Industrial Robotics; Impact of Technology on Competitiveness of U.S. Electronics Industry; Strategic Command, Control, Communications, and Intelligence; Computer-Based National Information Systems; and Information Technology and Education.

In the area of Materials Sciences (#2), relevant OTA studies include: Wood: The Material, the Resource; Industrial Energy Use; Medical Technology and the Handicapped; Space Policy and Applications; and Impact of Advanced Air Transport Technology.

OTA's work related to The Space Shuttle (#3) and Satellite Remote Sensing (#4) includes the following: Space Policy and Applications; Solar Power Satellite Systems; and Radiofrequency Use and Management: WARC 1979.

Finally, with respect to Recombinant DNA (#5), OTA completed a major assessment on Impacts of Applied Genetics (including recombinant DNA) nearly a year ago and is currently conducting follow-on studies as listed: Comparative Assessment of the Commercial Development of Biotechnology and Genetic Screening and Cytogenetic Surveillance in the Workplace.

Question 7. One of the most important questions this Commitee can ask is: How do the Committees of Congress use OTA's work? Please give some specific examples.

Answer. OTA's responsibility to Congress is to help sift through a welter of facts, claims, counterclaims, and analyses about technical issues in order to arrive at an accurate understanding of the facts and an objective set of sensitive, alternative policy option for the Congress. One measure of success used by OTA is to have the Report quoted by more than one side in the Congressional debate or otherwise used in Congressional deliberations. Another measure is whether the policy issue is resolved by Congress in a time related to the delivery and use of OTA's products and if the resolution is the same as or closely similar to one of the options identified by OTA.

Several of the examples drawn from OTA's work for the 96th and 97th Congress illustrate areas where OTA helped identify areas where less governmental action was appropriate (e.g., less regulation or lower Federal investment); others revealed areas where changed or increased government involvement was justifiable. Of course, OTA does not pretend to know the exact extent of impact its work has had on these complex issues which are influenced by many players and factors. The examples follow:

(1) *East-West technology transfer/Soviet energy availability.*—The first of these studies, East-West Technology Transfer (Requester/recipient: Senate Committee on Banking, Housing and Urban Affairs, House Committee on Science and Technology, and House Committee on Foreign Affairs) was delivered just before the Soviet invasion of Afghanistan made trade with the Soviets a major issue in U.S. policymaking and diplomacy. The second study, Soviet Energy Availability (Requester/recipient: same Committees as above, and Senate Committee on Foreign Relations) was completed in November, 1981, in time to be heavily used by both Houses of Congress, as well as the Executive Branch, in considering how to react to the Soviet-West European gas pipeline deal and the coup in Poland. Among other things, the latter study clarifies the longstanding uncertainties about projected Soviet energy production. It has been extensively quoted in Congressional testimony by the State, Defense, and Commerce Departments concerning the Soviet gas pipeline to western Europe as well as broader issues of Soviet energy, foreign trade, and the Western Alliance. The value of OTA undertaking studies on emerging issues with sufficient lead time to analyze them carefully is underscored by these studies, which have been classed as the most definitive in existence.

(2) OTA was mandated by Congress to undertake a critical, objective review of the plan (being developed for the Veterans' Administration) to evaluate the long-term health effects on U.S. forces of Agent Orange exposure during the war in Vietnam. The implications for future Federal costs could be enormous, so it is particularly important that the evaluation be made as accurately and carefully as possible. The proposed protocol for the evaluation was found by OTA to be seriously flawed and deficient and recommendations were provided concerning a variety of improvements. The revised protocol has included many of OTA's suggestions and appears to be much stronger. (Requester/recipient: Senate and House Committees on Veterans' Affairs, Senate and House Subcommittees on HUD-Independent Agencies of the Appropriations Committees).

(3) As early as 1975 OTA began a series of studies of energy supply and demand. These helped influence the form of a variety of Congressional actions, including the incorporation of efficient utilization in Federal research, regulatory, and incentives programs. Studies delivered to the 96th and 97th Congresses included Residential Energy Conservation (Requester/recipient: Senate Committee on Energy and Natural Resources, Subcommittee on Energy Conservation and Supply; Senate Committee on Banking, Housing, and Urban Affairs; House Committee on Interstate and Foreign Commerce, Subcommittee on Energy and Power; House Committee on Banking, Finance, and Urban Affairs, Subcommittee on Housing and Community Development; Senate Committee on Governmental Affairs; and House Committee on Appropriations, Subcommittee on Interior; briefings were provided for House Committee on Science and Technology Subcommittee staff and Senate Committee on Commerce staff), a Critique of DOE Solar and Conservation Programs (Requester/recipient: House Committee on Science and Technology; briefings were provided for Senate Committee on Energy and Natural Resources, Subcommittee on Energy Conservation and Supply; and House Committee on Banking, Finance, and Urban Affairs, Subcommittee on Housing and Community Development), and a review of several schemes for satellite-based solar power systems (Requester/recipient: House Committee on Science and Technology). (OTA's studies on oil from shale is discussed separately below.) Several observations can be made about the impacts of these studies. First, OTA's analyses gave early, quantitative evidence of the positive impact of higher energy prices on triggering more productive (efficient) use of energy. Second, the likely trajectory of energy demand growth in an era of higher cost was seen to be sharply lower than conventional wisdom, and this was shown to have very important implications for a variety of existing and proposed Federal programs of research, demonstration, regulation, and funding. Third, areas where national interest merits amplification of market signals (e.g., to use energy more productively, to assist consumers in adjusting to higher energy prices, to preserve and improve the nuclear option) were identified.

(4) *Oil shale technologies.*—This work included assessment of alternative technologies to produce oil from shale; examination of the likely price of (and markets for) the outputs; and considerable analysis of the regional impacts of western shale development on water availability, communities, worker health and safety, and the environment. The work on shale oil was a part of a more comprehensive review of synthetic fuels strategies that OTA has conducted in the past several years for the Congress. In the shale oil report we made a strong case for reducing the Federal involvement by about $70 billion dollars. Assessment of Oil Shale Technologies and our study on Energy from Biological Processes were used by Congressional staff to write the Energy Security Act of 1980. The study has also been helpful to the Executive Branch (especially the Department of Energy and the Department of Interior) in determining the advantages and disadvantages of various actions and funding schemes. (Rquester/recipient: Senate Committee on Energy and Natural Resources; Senate Committee on Banking, Housing and Urban Affairs; briefings for various individual Members.)

(5) *Federal vaccine and immunization policies.*—The Federal government is the single most important determinant of this Nation's commitment to vaccine research, development and use. Public monies are used to support vaccine development and to purchase vaccines for public immunization programs. The study included a cost-effectiveness analysis of vaccination against pneumococcal pneumonia. Based upon the OTA findings, legislation was introduced in both chambers of Congress to permit Medicare reimbursement for the vaccine (previously prohibited by law by the Medicare program). Congress passed such a law in late 1980. Prior to passage, the Congressional Budget Office (CBO) validated the OTA findings that pneumococcal immunization is a relatively inexpensive health care benefit that would improve the health of the Medicare population (and save 5,000 lives over a five-year period and yield a net savings to the Medicare program after four years). (Requester/recipient: House Committee on Energy and Commerce; Senate and House briefings)

(6) *MX missile basing.*—In its analysis of MX basing alternatives, OTA took care to present both the strengths and weaknesses of each of the major options, and to clarify how trade-offs such as survivability-vs-early availability are involved in any choice. OTA provided quantitative comparisons wherever possible and took special pains to discuss the effects of likely Soviet reactions to each U.S. basing option. This process not only clarified the issues, but provided Congress with its only source of technical analysis that was not linked to advocacy of one or another basing mode.

The cost for OTA to perform this key critical analysis and integration of information for the Congress was surprisingly small when compared to the cost of the detailed studies it utilized.

(a) The environmental impact anlaysis alone for the Air Force baseline MX plan cost more than thirty times as much as the entire OTA study.

(b) The present rate of Air Force research and engineering expenditures on the MX covers the entire (one year) OTA project cost about every 30 minutes. Congress, similar to corporate management, can consider this a small investment in order to better assure the wisdom of the larger investment.

(Requester/recipients: Chairman and Vice Chairman OTA Board; Senate Subcommittees on Defense and Military Construction of the Committee on Appropriations; House Subcommittee on Public Lands and National Parks of the Committee on Interior and Insular Affairs; Board hosted briefing of key Senate and House Members; several briefings to individual Members.)

The CHAIRMAN. Thank you for coming, Dr. Gibbons. Let me ask you kind of a hypothetical question. Very recently, within a matter of just the last few years, there has been a good deal of press speculation about DNA, and that immediately conjured up in the minds of the public—and the minds of the public include the minds of the Congress, Members of Congress—the specter of test tube babies, not in vitro fertilization, as we have seen in recent months, but actually test tube babies, fully manufactured human beings, that kind of thing, which of course is relatively fantastic state of the art, as we know it.

But nonetheless those are the kinds of specters that arise. And there was a very nearly successful attempt to throttle DNA research and development, based in part upon a lack of understanding of what it was, what it was likely to be, what the purposes and utilization would be.

Now, when that sort of thing comes about, how can you move to correct that impression, at least within the Congress if not within the country?

Dr. GIBBONS. OTA finished nearly 1 year ago an extensive project on the impacts of applied genetics. In order to be reasonably bounded that study covered single-cell organisms, plants, and animals, but didn't try to get into human applied genetics, except by inference from developments in the basic science.

One of the consequences, in retrospect, of our delivery of that assessment was that the lingering debate on the role of the Federal Government in regulating research with recombinant DNA was, I believe, finally concluded. OTA found that the internal controls taken by the participants in that research over a number of years had proven to be sufficiently conservative and that the system basically was working. This is an example in which basically OTA's analysis revealed the system is working rather well, and that there is no need for Federal action in terms of regulating that kind of research.

OTA's Board initiated that study at the recommendation of the Director, rather than awaiting a direct request of a committee. The report has proven to be very popular in terms of both congressional and noncongressional interests. It has undergone several printings at the Government Printing Office, and it was chosen as the Science Book Club book of the month about 2 months ago. It's the first OTA publication that has become a book of the month.

We are pleased, therefore, Mr. Chairman, not only that this information was provided to Congress and used in testimony and committee briefings, but has been widely used in the private sector, including, for example, by people who further translate that information and provide it to the public.

So I feel in this case that OTA's work has been one to help clarify the issues, identify the opportunities that arise from this advancing research, and contribute to increased awareness of the American people about the manifold implications. I feel, incidentally, that bioengineering is one of several areas of the micro world, the molecular world, that will continue in the decade of the 1980's to be revolutionary in every sense of the word.

The CHAIRMAN. Now let me ask you a housekeeping question. There was some cynical lady who once said that you could never be either too thin or too rich. Are you too rich, or are you not rich enough? Or have you got about the right kind of budget?

Dr. GIBBONS. Well, one advantage of OTA and its Board is that with whatever budget it has, it simply sets the level at which requests for work must be cut off. Obviously I would be pleased to have more resources because we could be more responsive to requests for assistance from committees. We have a number of things that we believe need to be done, particularly some longer lead-time items that involve looking a little further down the road. At present any resources directed to long term issues must be carefully balanced against the rising number of expressed needs for work that relates to the next several years of the Congress. That's understandable.

I think that our budget with respect to our staff is probably about right. If OTA had more budget, but no more staff, then we would be uncomfortably high in our proportion of external contracting, and would lack sufficient internal professionalism to adequately manage and integrate all the inputs.

OTA's current ratio of budget to staff is probably about right. It has remained constant in terms of real dollars and in terms of people for about 3 years now.

If OTA had substantially more resources, I would encourage the Board to permit us to spend a little bit more time thinking further ahead about emerging issues. Perhaps we would also expand our work in the area of national defense.

With regard to national defense, I might add that OTA largely avoided that subject until about the summer of 1980, when we undertook the MX basing study. We have now completed that work. We are presently engaged in a successor piece of work on command-control-communications and intelligence [C^3I]. This represents about five percent of our activity, and if OTA had more resources, I would say that work should be expanded, but not to the point that it becomes more than perhaps 15 percent of OTA's effort.

The CHAIRMAN. One other question of a practical nature. What is the relationship between OTA and the other service organizations that surround the Congress, the CBO, the Library of Congress, the GAO? Your mention of some work in the defense area prompts this question really, because CBO has taken over a function in tracking the multiyear defense programs. If you start on an aircraft carrier today, it might be 10 years before that ship ever hits the water. So that is beyond the annual appropriations cycle of the Congress; it extends beyond even the political life of many Members of Congress. So it becomes an important institutional memory.

Now, what is your—how do you interact with CBO and GAO and the Library?

Dr. GIBBONS. Let me see if I can give you a couple of insights into that, Mr. Chairman.

Consider our work on the MX missile basing issue.

During the course of OTA's study of MX missile basing, there was a series of mutually beneficial interactions with our sister agencies.

OTA's study began about a year after the Congressional Budget Office completed a substantial study of the costs of the MX under several alternative assumptions. Consequently, at the outset of our study, the OTA staff met twice with the analysts who had worked on the CBO study and received a number of valuable suggestions about sources of data on costs. When OTA's study reached the point where we were able to provide an interim briefing on our findings, the Senate Appropriations Committee became particularly concerned about the impact on the cost of MX basing if OTA's analysis of the projected Soviet threat proved to be correct. OTA's analysis showed that this cost would be very high. The chairman of the Appropriations Committee therefore asked CBO to assess these costs using OTA's threat analysis and the Air Force's cost estimation methodology—which CBO had the capability of duplicating. OTA provided the necessary details of the threat estimate—which were classified—to a cleared member of the CBO staff, and CBO carried out the requested analysis. OTA's final report used this CBO analysis to show that OTA's cost estimates differed from those of the Air Force more because of difference in threat estimates than because of differences in costing methodology.

The General Accounting Office maintains a field staff at Norton Air Force Base, San Bernadino, Calif., which devotes a substantial amount of time to auditing the costs, schedule, and adherence to procedures of the Air Force MX program. During the course of OTA's study, OTA's staff met about once every 6 weeks with this GAO staff, who were often accompanied by their supervisors in the Los Angeles regional office and in Washington. We found the GAO staff a useful source of data on costs, and a particularly useful source of insights about the factors that were forcing the program to fall behind schedule, and the difficulties that would be involved in making up this lost time. We believe that the GAO found our staff a useful source of technical information; GAO's interim report of January, 1981, explicitly referred the Congress to OTA for information regarding certain technical issues of MX development. GAO also has a staff at Wright-Patterson Air Force Base, Dayton, Ohio—reporting to the Cincinnati regional office—which during the period of OTA's study was engaged in an assessment of the adequacy of U.S. stragegic nuclear forces to meet the demands placed upon them. The individuals engaged in this effort met several times with the OTA staff, comparing notes about the assumptions that apparently underlay Air Force planning efforts.

The Congressional Research Service staff was constantly faced with questions regarding MX during the period when OTA's study was going on. The CRS obtained information from a number of sources, including documentary research, and the convening of panels of experts. Their staff also consulted frequently with the OTA project staff. We supplied them with a substantial amount of technical information. We found CRS to be a valuable and reliable source of information regarding the status of various legislative initiatives and of congressional action on executive branch proposals. OTA and CRS worked together to supply information to the House Interior Committee and its staff.

Our experience in the MX study was that there was little overlap because the four congressional support agencies were carrying out different kinds of analyses to answer different kinds of questions. However, we all benefitted from the frequent information give-and-take at the staff level.

[Information from the study follows:]

Major milestones of OTA's MX Missile Basing study:

May 1980: Study initiated by Technology Assessment Board.

March 1981: Classified briefing on interim results to invited Members of the Senate and House.

March 1981: Unclassified briefing on interim results to Subcommittee on Public Lands and National Parks of House Committee on Interior and Insular Affairs.

March 1981: Informal consultation with staff of Senate Armed Services Committee.

April 1981: Classified briefing to "Townes Committee" (set up by Secretary of Defense Weinberger to advise him on MX Missile Basing).

May 1981: Informal consultation with staff of Senate Appropriations Committee.

May 1981: Informal classified consultation with members of House Interior Committee.

June 1981: Draft final report submitted to TAB (one chapter omitted while classified problems resolved).

June 1981: Classified testimony before Defense and Military Construction Subcommittees of Senate Appropriations Committee.

June 1981: Unclassified briefing of Public Lands and National Parks Subcommittee of House Committee on Interior and Insular Affairs.

June 1981: Publication of summary of report.

(July 1981): Townes Committee reports to Secretary of Defense.

August 1981: Final agreement with Defense Department regarding what was and was not classified.

September 1981: Publication of final report (unclassified).

(October 1981): Announcement by President Reagan that MPS basing system would be dropped.

(Winter 1982): Completion of classified annexes.

Dr. GIBBONS. The extent of productive interaction between the agencies is increasing because we are getting to know each other better. At the same time the missions, methods, and procedures used in the four agencies are quite different. This fact places a natural limit to the practicality of increasing their interactions without limit. For example, I have reservations about a full joint venture between two or more agencies as being more than a very occasional affair. The different agencies approach major issues from very different directions with different methodologies and objectives. In a word, for CBO, budget impact is the primary focus; GAO is involved in a program and financial audit analysis; and the Congressional Research Service does a mammoth amount of work in documents analysis, identification of major policy issues, and legislative histories.

OTA's job is more prospective than retrospective; it examines emerging technologies and associated impacts; it uses the analytical methods of science and engineering but also of economics and policy analysis. OTA's studies are generally more comprehensive in scope.

OTA is unique in having a Congressional Board, Project Advisory Panels of outside experts, substantial external contracting with specialists from around the country, a broad external review process, the wide availability of its findings, and the fact that really all of its work is in response to committee requests. These characteristics make our mode of operation sufficiently different from the other agencies that, while collaboration and cooperation are very effective and easily done, full joint ventures present some problems.

The Comptroller General and I have been working on this question. Some joint ventures may emerge. Meanwhile the extent of helpful interagency cooperation has never been greater and we intend to build upon our successes.

I would like to paraphrase a comment made to me by one member of TAB. He said he felt that the last thing Congress wants is one piece of advice derived from one support agency; he would like to have two or three different groups giving him advice, on the same issue, especially if it's an important one. But each group should approach the issue from very different perspectives using different methods, whether it be an econometrics approach or an engineering assessment or fiscal analysis. And then he wants to make up his mind how the several different inputs are weighed, in his judgment, in terms of making the decision.

So I think that while we have a lot of cooperation, I would be worried about all the agencies just giving you a single answer when you ask a question.

The **Chairman.** Governor Brown of California, who aspires to be one of your clients, has said that one of his techniques in approaching his duties as Governor—and I assume that this wouldn't change very much if he should in fact come to Washington—is to read the technical science magazines where concepts and ideas are first published, the kind of things that a year or two later may end up, after there is some practical application, on the science pages of Time and Newsweek—but by picking them up early in the science magazines as just ideas, he can test them out, discuss them with the public and get reactions from the scientific community.

Is there any one on your staff who does this kind of prospective digging on ideas that may or may not ever reach the science pages of Time.

Dr. **Gibbons.** I expect my staff to do a lot of reading, to fall asleep over literature more nights than not. We have a central operation at OTA called our Information Center which maintains current professional journals and a variety of ways to attract people in the door to read them. We have electronic access to over 200 specialized bibliographic services. We do a great deal of review and interaction with people in a variety of science and technology communities. In fact, it's a two-way flow: our material flows back out to that community. For example, in the latest issue of Science magazine, two different OTA studies were included in their recent analysis of activities.

Governor Brown has visited us within the last 6 months and requested to receive our current Assessment Activities. We find, Mr. Chairman——

The **Chairman**. That's a bit of intelligence his opponents may want to know about.

Dr. **Gibbons**. We find that it is essential that we stay on top of the scientific literature, and that also means not just science but the technology that one sees emerging from that science.

And I think the fact that some 2,000 people besides our own staff work with our organization every year, in terms of providing expertise, that we have up to half a dozen fellows who are with us for a year at a time that continually expose our staff to new ideas is a terribly important thing for us to be encouraging and insisting on happening.

Incidentally, Mr. Chairman, I tested the system the other day when I read in a daily newsletter concerned with science and technology developments of a new theory about acid rain, how to track it and the like. I said: my goodness, I better find out if my people who are working on atmospheric pollutants know of this. So I asked them. They not only knew about the work, but they had talked with the person and had already done an independent analysis of just how good that research was.

In OTA's annual report to Congress we are attempting to provide a review of what OTA accomplished during the year and also a brief overview of the future directions of technology generally.

The **Chairman**. You commented in response to my question about the other congressional agencies that you felt that it was good to have a couple of different opinions on the same subject—and I certainly would concur with that. But maybe you can have too many duplications.

Do you think the work of OTA does differ significantly from that of the national academies and the nonprofit think tanks and the commercial research firms and the academic groups?

Dr. **Gibbons**. I believe so, or I wouldn't have uprooted family to come to Washington. I would try to answer in this way. When we undertake a study, having determined that there is enough information for a decent analysis, the first thing we do is find out not only what is printed and known about the issue, but who is currently working on that issue. Therefore, we identify the people, and know the literature before we begin work. Our starting point in a study is to build upon those analyses that have come from those very groups that you spoke of, and then go beyond that to identify where they disagree and, if so, why. Then we get enough people representative of the parties-at-interest so we can help sort out the facts and how they are interpreted by the various parties-at-interest and help narrow the debate down to those issues which can't be agreed upon or where the data is inconclusive.

We find that once we start this process, frequently in the course of our work we are able to not only satisfy the needs for facts but also resolve the reasons for differences and different technical opinions. Therefore, we hope, we aid the committees in being able to focus on the issues that are going to have to be a matter of adjudication.

The CHAIRMAN. I have just one final question. Have you had any objection to the OTA public publishing program? How does that interrelate with its mission to Congress? Let's again put this in a highly hypothetical phase, but could OTA in effect become a major lobbyist through publishing to the public when it isn't able to persuade within the walls of Congress?

Dr. GIBBONS. First of all, we don't recommend specific actions; we provide options rather than recommend actions. Thus we are not in the position of advocacy.

Second, we deliver to the Congress. The GPO publishes our work for use by the Congress. It prints additional copies for sale to the public. If people want a copy of an OTA report they normally have to purchase it. If they are people that have helped us, such as members of an advisory panel, we are happy to supply them with a copy; other people have to buy the material. Of course we are pleased when the public is interested in our work. The act that created OTA encourages the agency to make its results available to the public.

There is a procedure for allowing a private publisher to obtain and republish Federal information at no cost to the Government. If the publisher makes a profit, that's fine. In a way I am pleased that this is happening to most OTA reports, because it means that the private marketplace considers the information sufficiently worthwhile to send it further out into the various private sectors of the economy. It reduces the cost at OTA in terms of responding to requests for information.

We are pleased that public attention is given to our products, but I have not been criticized that we are out trying to proliferate our publications around the land. In fact, we depend on sales of our reports. We don't give away many copies. GPO sold about $200,000 worth of OTA publications in 1981. I am sorry we don't get the funds from those sales, but the GPO does.

The CHAIRMAN. It needs it. Well, thank you very much, Dr. Gibbons, for your testimony here this morning. I have some other questions of a fairly technical nature, and I am going to submit those in writing and request that you respond to them in writing and that exchange will be part of this record.

Dr. GIBBONS. We will be pleased to respond, Mr. Chairman.

The CHAIRMAN. We also have several Members of Congress who were unable to be here today who wish to participate, and therefore I am going to hold the record open for 1 week for any statements or questions that they may wish to propound, in particular Senator Mattingly, chairman of the Appropriations Subcommittee on Legislative Appropriations, would like to have some input.

So we will hold the record open for 1 week.

I have at this time a statement by the distinguished Senator from South Carolina, Mr. Hollings, which we will include as a part of the record.

[The prepared statement of Senator Hollings follows:]

PREPARED STATEMENT OF SENATOR ERNEST F. HOLLINGS, MEMBER, TECHNOLOGY ASSESSMENT BOARD, OFFICE OF TECHNOLOGY ASSESSMENT

Mr. Chairman, I regret that another commitment makes it impossible for me to appear in person this morning. Nevertheless, I am delighted that this Committee is holding oversight hearings on OTA and I would like to submit my views for the record.

Mr. Chairman, I have been a Member of the Technology Assessment Board since its inception in 1972. OTA was established to provide Congress with the technical capability to deal intelligently and effectively with the array of science and technology issues that Congress must confront. One of the most striking developments in my sixteen years in the Senate has been the growth in the number and complexity of technology-related issues before the Senate. The pace of technological advance in telecommunications, health, agriculture, energy, defense and other areas has been staggering, and it has not been easy for the Congress to keep pace.

OTA has performed an invaluable service, particularly in recent years, in helping us understand the public policy options and implications that technology presents. For example, OTA's recent assessment of MX missile basing was the only study to lay before the Congress a systematic and authoritative comparison of the basing options available and their budgetary, defense, environmental and other implications. If Congress is to make wise choices in an era in which constricted budgets force tough choices, it must have the kind of hard information that OTA provides. OTA is particularly valuable in this respect because it draws upon the most knowledgeable people and organizations in the country as it does its work. For example, the Advisory Panel on a just completed OTA assessment of international Radiofrequency Use and Management consisted of former senior officials of NASA, the State Department, the Naval Electronic Systems Command, as well as nationally known scholars from MIT and Georgetown—to name only a few. Typically, OTA assessments tap the best minds in industry, universities, public interest organizations and government. Congress needs the best and OTA has proved to be a way to get it.

Finally, Mr. Chairman, let me emphasize that OTA is a truly bipartisan resource. Both parties are evenly represented on its Board. It services both Majority and Minority requests from Committees. It serves all Committees. It is, as my distinguished colleague, Senator Stevens, has said, a "shared staff" of the Congress—and it works.

The CHAIRMAN. I would also include for the record statements of Gilbert Gude, Director of the Congressional Research Service; Alice Rivlin, Director of the Congressional Budget Office; the Comptroller General of the United States; the American Association for the Advancement of Science; Exxon Research and Engineering Co.; the University of Oklahoma at Norman; the Burroughs Corp.; and the Midwest Research Institute.

[The prepared statements and material referred to above follow:]

PREPARED STATEMENT OF HON. GILBERT GUDE, DIRECTOR, CONGRESSIONAL RESEARCH SERVICE, LIBRARY OF CONGRESS

As you might imagine, running CRS is very much a full-time job. My staff and I regularly assess how our work meshes with what is being done in the other support agencies, but this is a much more limited task than the one you asked me to undertake with respect to the Office of Technology Assessment in your letter of January 18, 1982. As a member of the Technology Assessment Advisory Council, I am especially aware of OTA activities. To look seriously at what OTA is and ought to be, and its administration, is a challenging task. It was a most useful exercise.

Obviously, one cannot look at OTA in a vacuum. As only one of four legislative support bodies, OTA needs to be considered relative to the role of the other three support agencies.

The Office of Technology Assessment, the Congressional Budget Office, the Congressional Research Service, and the General Accounting Office are all asked by the Congress to provide in-depth policy studies, provide support on issues in areas of interest to the Congress, respond through a variety of communication modes, and apply a broad spectrum of methodologies. Each of these agencies maintain staffs of a high level of expertise; each has certain specific characteristics of staff capabilities and response capabilities. Quite naturally the thought persists that since they share a common general mission—information or knowledge uniquely tailored to the legislative and oversight needs of Congress—and a common client—Congress, they are somehow alike. Nothing could be further from reality.

Each of these organizations has its own specific legislative mandates. Each has developed policies and operational styles which are a function of that mandate, what it provides, and in the time frame in which it operates. And each has been shaped by its own organizational history.

I believe that the most useful contribution I may be able to make to your oversight effort is to contrast OTA with CRS in order to highlight the key differences between us.

As the oldest of the legislative support agencies, the Congressional Research Service provides some historical perspective on how the changing needs of Congress translate into changes in their support agencies.

The Library of Congress had already been providing library support to Congress for over 100 years when Congress emulated Wisconsin's Legislative Reference Service and voted to establish a similar service for the U.S. Congress. In 1914 Bob LaFollette, arguing for the establishment of LRS stated, ". . . ultimately this service will be adequate to furnish promptly and in convenient form exhaustive information upon existing laws and proposed legislation, both in this and foreign countries, so essential to the current work of Congress."

Over the years the information needs of Congress changed, as did the Congress, and became more complex and interrelated. The Legislative Reference Service, utilizing the incomparable resources of the Library of Congress, gradually had its mandates broadened from the performance of only relatively pure and simple reference work to include sophisticated research/analytical work.

One milestone in this transition was the establishment, in 1946, of the LRS senior specialists—a specifically authorized core of high-level experts who are well known authorities in fields ranging from science through income maintenance. The Congress was determined to command a body of expertise which was every bit a match for that available in the executive branch. The establishment of the senior specialists at CRS was one vehicle through which it chose to accomplish this goal.

A second major milestone in CRS's development—indeed part of a sea of change in the configuration of the Congress itself—was the Legislative Reorganization Act of 1970. LRS became CRS. We were directed to expand our staff significantly, augment our senior specialist corps, and broaden our service base to serve all committees. CRS support to committees has changed drastically since 1970—from 20 percent to currently 50 percent of our total effort. Further, we were provided modest funding for the utilization of contractual expertise to handle short-term surges in demands for our services and fill occasional gaps in CRS staffing so we could provide Congress the comprehensive coverage of national issues they expected of us.

Today we have, in addition to our senior specialists, in-house analysts and specialists organized into seven research divisions, as well as the Library Services and Congressional Reference Divisions who continuously track and provide expert and rapid support on all national issues in such fields as economics, human and natural resources, agriculture, welfare, science, the environment, the technologies, law, defense, and foreign affairs. Congress has shaped us over the years to fit it needs. CRS serves no one else.

CRS staff know this: they are part of the warp and woof of Congress. Congress provides their total livelihood and commands their total professional loyalty. The legislative calendar paces and permeates all the work they do, from quick turnaround reference work to analytical studies. Consequently, deadlines have a special and very real meaning to CRS.

Everyone concerned needs to understand this bit of background on CRS to really understand the sharp structural difference between CRS and OTA.

OTA was established because of a perception within Congress that a need was not being satisfied by the existing agencies—specifically, the need to extensively examine issues for beyond immediate legislative concerns. I was a Member of Congress when OTA was established; I remember quite clearly the extensive debate on the SST impact on the earth's ozone layer and the dismay at realization of the fact that there were no comprehensive studies of the long-term damage potential to our environment.

Thus, one important difference between CRS and OTA is the fact that their major assessments are usually considerably larger and more futuristic than ours. These more ambitious projects, by the very nature of their time scale, are likely to take longer to produce. As a result, the terms of the debate they address sometimes change between initiation and completion. The OTA assessment on the MX basing is an example of this. It was an excellent, technically proficient study; yet by the time it was completed, the debate in Congress had shifted away from a central focus of the assessment, Multiple Protective Shelters, making the study less useful than it might otherwise have been. Thus, a particular challenge for OTA is to do analyses that have a long-term time perspective within a time frame that is responsive to the needs of congressional decision-making.

A unique aspect of the OTA methodology, and one which clearly differentiates it from CRS, is the extent to which they utilize contractors. Both OTA and CRS value the flexibility afforded by contractual support, but the degree to which we use this is less by several orders of magnitude. Moreover, we use the capability in different ways. OTA's reports and assessments regularly involve contracts with "primary source" personnel—industry and academic, often operating in panels—for the preparation of original external research or data-gathering papers. Further, the time spent on OTA projects, while much longer than is typical for CRS, permits a more in-depth consideration of the wide range of options associated with the issue being studied.

Such use of contractors was deliberately designed into the authorization for OTA so it might gain access to "assessment options" which could be overlooked in the more intense environment of legislative activity in which CRS works most frequently. This OTA style of operation leads to an emphasis on synthesizing the basic research of others. In contrast, CRS depends primarily on our in-house staff expertise and their professional contacts and associations, supplemented, of course, by their own collections and those of the Library of Congress.

Other major differences between us may be well known to you but are still worth recalling. We provide support to the entire Congress, committees and staff; OTA responds to specific committees and the Technology Board. We cover the entire spectrum of congressional concerns; OTA, by definition, focuses on technical issues. And as you know, we are specifically prohibited from going "public" with our products; OTA is directed to publish its studies and consequently has a full-time press officer who routinely provides OTA Publication Briefs, press releases, and other documents to the media.

Our professional staff of 550, while small by most Washington agency standards, is considerably larger than the 90 or so OTA full-time professional staff. In terms of budget, of course, we are much closer in size. Naturally, this difference in staff size is reflected in our workloads. Last year, for example, we handled 373,000 congressional queries. Included in that figure are thousands of reports and several hundred major studies. it is also reflected in the ability of CRS to provide support to our sister agencies. We have regularly provided OTA research assistance in a variety of ways. We have helped scope issues, since OTA is less able to track problems than is our larger staff. We have assisted in setting up and participating in advisory committees, identified appropriate consultants, designed study configurations, provided peer review and continued to track subject areas after the OTA project team has disbanded. CRS experts also sit on OTA panels. In addition, in FY 1981 our Congressional Reference Division responded to more than 500 reference inquiries from OTA.

Although we obviously do not do this on all OTA assessments, a number of specific cases come readily to mind, e.g., their studies on forestry, rangeland and agricultural productivity, use of synfuels for transportation, space, societal impact of national information systems, high level radioactive waste management and disposal, impacts of applied genetics, energy from wood. These instances suggest a sustained level of CRS support.

Other forms of CRS cooperation with OTA, both in the spirit of providing assistance and avoiding duplication, are too well known to you for me to dwell upon—my membership on the Technical Assessment Advisory Council, our publication of the Research Notification Service, and joint participation in new Member orientations.

To summarize, it is my considered opinion that OTA provides a useful service to Congress. Our organizational relationship is cordial. I see no evidence of substantive duplication in the services our respective organizations provide Congress. Indeed, we are currently mandated, staffed, funded and structured so differently that at this point in time I frankly cannot foresee how CRS and OTA would ever provide Congress substantially the same information services. Suggesting we are duplicative because we both serve the information needs of Congress is tantamount to thinking that football, lacrosse and baseball are identical because all involve use of a ball!

PREPARED STATEMENT OF ALICE M. RIVLIN, DIRECTOR, CONGRESSIONAL BUDGET OFFICE

Mr. Chairman and Members of the Committee, I am pleased to have this opportunity to comment on the relationship between the Office of Technology Assessment (OTA) and the Congressional Budget Office (CBO).

Before doing so, it might be helpful if I briefly review the legislative mandate of CBO. The CBO is a nonpartisian organization that provides the Congress with budget-related information and analyses of fiscal, budgetary, and programmatic issues. CBO does not make recommendations on matters of policy; rather, we analyze options—their costs to the federal government, their impact on the national economy, and their specific potential programmatic effects. The agenda for CBO, as set by the Congressional Budget Act of 1974, is very specifically focused on budgetary and economic matters. Accordingly, CBO's workload is a direct function of the progression of events and decisions in the budget process. We must be prepared to provide a variety of services, ranging from technical budget elements to in-depth analyses of choices for the functional composition of the budget. Therefore, we have assembled a highly trained staff of economists, budget specialists, and federal program analysts. The Budget Act establishes the following committee priority for CBO's provision of these services: first, the Senate and House Budget Committees; second, the Senate and House Appropriations Committees, the Senate Finance Committee, and the House Ways and Means Committee; and finally, all other Congressional committees.

The quite different mission of OTA is to provide the Congress with information about the possible consequences—social as well as physical—that can be expected to accompany or result from legislative decisions affecting the use of technology. To fulfill its mandate, OTA is staffed by specialists in the physical and biological sciences and in engineering. The breadth of OTA's mission, and its highly specialized nature, go beyond the expertise that any single agency of OTA's size can furnish. Therefore, OTA also relies heavily—and most effectively—on the scientific and technological expertise of resources outside the agency. The CBO, in contrast—in keeping with our legislative mandate and our integral role in the budget process—can furnish nearly all of its own expertise.

Though CBO and OTA often work within the same broad areas—agriculture, defense, energy, and so on—the focus and substance of these efforts are quite distinct. OTA provides the Congress with analyses of specific emerging scientific and technological issues; CBO provides the Congress with economic and budgetary information. But the distinctiveness of the legislative mandate of each agency does not preclude cooperation between the two; in fact, it encourages cooperation. With mandates clearly defined, neither agency branches out beyond its own purview. Instead, both seek cooperative efforts when appropriate.

Within the last year, for example, CBO and OTA have coordinated on several key issues. For the Senate Committee on Energy and Natural Resources, CBO analyzed the cost of nuclear waste disposal to complement an OTA analysis of technological issues. For the Senate Environment and Public Works Committee, we have cooperated with OTA on analyses of the impact of the Clean Air Act. For the House Committee on Energy and Commerce, we are currently doing a study on the effects of natural gas prices on energy markets and the economy; OTA is at the same time assessing potential U.S. natural gas availability.

This cooperation between OTA and CBO is part of an overall effort by all four Congressional support agencies—including the General Accounting Office and the Congressional Research Service as well as OTA and CBO—to provide the Congress with expertise while avoiding duplication. We have formalized these efforts through the following mechanisms:

An interagency coordinating group, composed of senior staff of each agency, which meets regularly;

A list of all ongoing and recently completed projects of all four agencies—the Research Notification System—which is circulated monthly throughout the agencies;

Periodic meetings of subject-area specialists to discuss current and planned projects, possible coordination, use of existing information, and sharing of data; and

A "guide to analysts," which is circulated to all staff in the four agencies to facilitate coordination.

It is our view that OTA provides an invaluable service to the Congress. We are most impressed not only by the high quality of OTA's output but also by the managerial skill entailed in achieving and maintaining that standard.

Comptroller General of the United States,
Washington, D.C., February 2, 1982.

Hon. Charles McC. Mathias, Jr.,
Chairman, Committee on Rules and Administration, U.S. Senate.

Dear Mr. Chairman: This is in response to your January 18, 1982, request for a statement for the record for your upcoming oversight hearing on the Office of Technology Assessment on February 5, 1982. In my recently assumed roles as a statutory member of the Technology Assessment Advisory Council and as head of the General Accounting Office, I have given thought to the importance of the continuing relationship between GAO and OTA, and the areas where each of the agencies can best serve the Congress. Since OTA was established in 1972, we have worked at developing a cooperative and productive relationship between GAO and OTA. I believe the relationship has now matured and we are exploring new opportunities to work even close together to better meet the needs of the Congress.

In October 1977, my predecessor as Comptroller General testified on OTA before the Subcommittee on Science, Research and Technology; House Committee on Science and Technology. He made several suggestions for improvements that he felt could strengthen OTA's structure and mitigate some of the problems OTA had at that time. His suggestions ranged from changing the rules governing appointment of OTA staff to undertaking assessments of defense technologies. Since that time, OTA has made a number of changes in the areas identified. These changes, in part, were needed to permit OTA to become a more effective tool in aiding the Congress to make difficult decisions involving complex technological issues.

In examining the areas where OTA can best serve the Congress, one must keep in mind the reasons why OTA was created. Researching OTA's legislative history reveals that the primary need to the Congress was for a special capability to examine emerging issues involving new or expanding technologies and to assess potential impacts. together with analyses of alternative policies and strategies for the Congress to consider before crises loomed or processes with undesirable consequences developed to an irreversible stage. I believe strong emphasis on this critical responsibility to identify emerging issues and provide an early warning is essential. The need was also expressed for the ability to bring together expertise to match the capabilities of the executive branch to cope with issues involving a strong science and technology component.

In reviewing some of OTA's current projects, such as those involving hazardous waste, wood. water, and atmospheric alteration, it seems to me that these kinds of activities fit in very well with what the Congress expects of OTA. They have a significant technological component, are future-oriented, and are difficult problems for the Congress to deal with. OTA must constantly try to balance its work between satisfying the need to address long-term issues and accomodating the short-term or immediate needs of the Congress. Attaining a good mix of tasks to meet these somewhat conflicting goals is a continuing and difficult management challenge for OTA.

I believe it is helpful to look at the way in which OTA provides its services to the Congress as part of considering how it can best serve the Congress. OTA's Director recently used an interesting and appropriate analogy to describe the role of OTA. He called OTA a "catalyst" and stated that OTA operates in the mode of a catalyst in that it identifies ". . . diverse sources of expertise and points of view about critical socio-technical isseues and then brings them together to catalyze productive interactions. This occurs via advisory panels, workshops, contractors, and a variety of review procedures which are organized to assimilate current national wisdom on the issues." I heartily agree that bringing diverse sources of expertise to bear is an effective technique for dealing with complex problems.

Efforts to insure cooperation and coordination between GAO and OTA began when OTA first became operational and have been increasingly successful in allowing the agencies to create an effective environment for the exchange of information. Both agencies have joined together to insure that respective roles are fully understood by staff at all levels. Each established policies and procedures to foster day-to-day cooperation and communication among staffs. For example, each agency has widely distributed publications describing what it does. Also, our respective staffs work together in the planning and performance of work and are alert to opportunities to effectively share knowledge or capabilities.

Good coordination has been accomplished successfully within the framework of each agency's individual role. Both agencies were established to perform substantially different roles for the Congress. As a general characterization, GAO evaluates the effectiveness and efficiency of existing programs while assisting the Congress in its broad legislative and oversight responsibilities. OTA was created to be an unique resources dedicated to assessing the impact of technlogical applications. While the roles and perspectives of the two agencies differ, both work in some of the same broad areas such as health, food, energy, and defense. Thus, the appearance of duplication or overlap may exist in connection with work which is substantially different. For example, both GAO and OTA conducted studies involving the MX missle. At first glance someone not familiar with the actual work could have construed these efforts to be duplicative, when in fact, a substantive look at the respective tasks would show that the work was actually complementary. At any given time, there may be a number of such GAO and OTA projects which might appear on the surface to be duplicative, but are in fact complementary in nature.

While the bulk of requests made to each legislative branch agency are usually clearly within their areas of individual responsibilities, there have been cases where a request is made to either OTA or GAO that was inappropriately directed. For example, a request was made to OTA for a study of the C–5A wing modification program. OTA did not feel the request was appropriate for them but rather should have been directed to GAO. Our current working relationship made it easy to get the request redirected to GAO.

There have been benefical assistance and information exchanges between the agencies which allows us to more effectively meet the needs of the Congress. For example, both GAO and OTA were requested by Congress to do work relating to issues surrounding cuts in funding to the Trust Territory of the Pacific and the effect of the cuts on its health and education programs. We discussed these requests and concluded that we could be most responsive to the needs of the requesting committees by having GAO assume the lead role with OTA providing information and analyses in its areas of expertise.

Earlier, I mentioned GAO and OTA are exploring new opportunities to work together to better meet the needs of the Congress. I have spent some time in recent weeks conferring with the Director of OTA about ways this could be achieved. In recent correspondence he has suggested, and I agree, that we should attempt to develop an explicit statement on the potential merit in identifying and capitalizing on symbiotic relationships between our agencies and that we should formulate criteria to provide guidance as to what actions or subjects would prove productive. Our staffs have already idenfified one project as an initial candidate for experimentation with a greater degree of collaboration between the agencies. On this project, OTA has decided to include a member of my staff as an ex officio member of the advisory panel of experts which is assembled as a integral part of OTA's projects. Our work together in this area is a first step towad significant future progress.

Again, I appreciate the opportunity to comment on the Office of Technology Assessment. I look forward to a continuing close and productive relationship with OTA. I believe this will benefit both GAO. and OTA, and will enable us each to better serve the needs of the Congress.

Sincerely yours,

CHARLES A. BOWSHER.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE,
Washington, D.C. February 3, 1982.

Hon. CHARLES McC. MATHIAS, Jr.,
Chairman, Senate Committee on Rules and Administration, Russell Senate Office Building, Washington, D.C.

DEAR MR. CHAIRMAN: I was pleased to see that the Committee on Rules and Administration will hold an oversight hearing this week on the Congressional Office of Technology Assessment.

From my observation, the reports of OTA in the past two or three years have consistently exhibited independence, balance, and solid analytical foundations. While the reports are intended for a variety of Congressional users, the fact is that they are valued highly by the general U.S. research and development communities, industrial and academic, and by the thoughtful sectors of the press This reflects credit both on the OTA and its governing bodies which have seen to it that partisan and otherwise biased tendencies have been rigoroulsy excluded from the output of OTA.

For your information, I am enclosing an editorial which I published in Science some months ago, noting the impressive contributions of the OTA and its maturing as a solidly-established professional arm of the Congress.

Sincerely,

WILLIAM D. CAREY,
Executive Officer and
Publisher of Science.

[From Science magazine, May 15, 1981]

SCIENCE POLICY AND CONGRESS

(By William D. Carey)

Some institutional innovations pay off. That is something to rejoice about, especially when they involve the performance of government in a public opinion climate that has made up its mind to be negative.

The Technology Assessment Act of 1972, fathered by then-Representative Emilio Q. Daddario, called for the creation of a professionalized center for studying the potentialities and impacts of emerging technologies. The Office of Technology Assessment (OTA) was established as an arm of Congress, designed to provide new depth and expertise to the work of committees of the House and Senate in dealing with technological controversy and risk, and complementing the efforts of the Congressional Research Service and the General Accounting Office.

Eight years later, OTA stands on its own feet as an effective and respected center of scientific and technological policy analysis. Its agenda is determined primarily by the questions put to it by committees and subcommittees charged with legislative responsibilities, although OTA has modest latitude to initiate studies under its own power. Quality control is seen to by a ten-member advisory council and an array of credentialed advisory panels, while a bipartisan congressional board of 12 members of the Senate and the House keeps OTA on target.

The roster of advisory panels provides a glimpse of the range of OTA's homework for Congress. The panels number 47 and cover a mind-boggling spectrum. There are panels on advanced High-Speed Aircraft, Radio Frequency Use, Space Technoloy, Electronic Funds Transfer, National Information Systems, Technology and Oceanography, Strategies for Medical Technology, Population, Impacts of Applied Genetics, U.S. Industrial Competitiveness, MX Missile Basing, Soviet Energy, Nuclear Powerplant Standardization, and Energy from Biological Processes. All this produces an enviable knowledge base into which the responsible committees of Congress can dip when confronted with near-term and long-range problems of policy choice. Considering that the appropriation for OTA comes to eight-tenths of 1 percent of the congressional operating budget, it would seem a modest enough investment in legislative capacity building.

A further point of interest is that there is no pretense that OTA is in business to make policy. This is a distinction better understood and practiced in Congress than in the Executive Branch, where presidential staff units come to believe that they are policy instruments of the President and behave accordingly. A very good reason for this difference is that Congress remains emphatically pluralistic and has nothing of the policy discipline that is so admired by the Executive Branch. An office of Technology Assessment in Congress could not last long if it were to push a line of its own.

For most of our constitutional history, the Presidencty has had the advantage over Congress in depth of resources for policy research and initiative. More recently, the insitutional capacities of Congress have become steadily more comparable. The striking modernization of the General Accounting Office, the solid performance of the Congressional Research Service, and the impressive outputs of the Congressional Budget Office and OTA are healthy signs for all who value the prinicple of separation of powers. Although there are critics of the growth of the legislative payroll, Congress is aware that guess and hunch make for flawed policy.

Within the present decade we will observe the bicentennial of the Constitution, an occasion for some festivities, perhaps, but even more an occasion for examining the workings of our political technology in an age of danger and risk. Institutions in good working order reflect the better side of government.

PREPARED STATEMENT OF EDWARD E. DAVID, JR., PRESIDENT, EXXON RESEARCH AND ENGINEERING CO.

Mr. Chairman, I am pleased to respond to your request to supply written testimony for the Committee's oversight hearings on the Office of Technology Assessment. OTA is, in my view, an innovative (and quite interesting) tool whose usefulness to the Congress has grown as the organization has evolved and matured. The services and insights it now provides are essential to the formulation of sound legislation in many subject areas.

The original mission of OTA was to anticipate the second-order consequences of the application of technology. I was one of many who viewed this initial direction as unrealistic. It is difficult enough to predict the primary effects of technology, let alone the secondary ones. Experience has shown that such prediction of future influences is largely beyond our current analytical capabilities. Beyond this concern for a realistic mission, I was afraid that OTA's activities would not stem from a balanced perspective and would focus on the negative side-effects of technology. I was one who cautioned that technology assessment must not become technology arrestment. Without data from experiments or trials, prediction goes off the track of reality. This concern was heightened by the early prospect that OTA would become a partisan political tool. These fears have not proved valid, and recent OTA reports have moved in the direction of objective presentations, descriptive of both the state of the practice and state of the art of the technologies under study. Thus, I believe that OTA's output has become more balanced and credible, and so potentially more useful to the Congress. In this process of maturation, OTA has become more selective and concerned itself with matters of central importance to the nation and the Congress.

OTA has some unique characteristics which make it peculiarly valuable to the legislative process. Specifically:

It occupies neutral political ground and does not seek to make policy.

It has access to the best experts in the country because it is a respected organization known to play an important role in the legislative activities of the Congress.

It brings together diverse opinions and viewpoints so as to display the inherent complexity of issues in the modern world. In a constructive vein, it lays out options for action in a non-partisan light.

Maintaining balance and perspective in the presentation of all sides of an issue is difficult. I would make one suggestion intended to address this problem constructively; namely, that the membership of the OTA Advisory Council have more industry representation. At present, there is only one member from private industry. Most of the OTA assessments concern technologies which are or will be, developed and applied by private industry. Currently, the board membership is heavily weighted toward government, and the academic and non-profit sectors. I believe that Congress, as well as the OTA staff would be well served by achieving a better balance through inclusion of more industry members.

I would also urge that OTA must have seasoned, experienced staff members and analysts, whose assignments, whenever possible, should be in their field of disciplinary training and work experience. This policy will help assure realism and objectivity in OTA activities.

Recently, OTA has begun producing one-page summaries of their assessment reports. I and my colleagues have found these summaries to be very useful, and I hope that this procedure will continue. Also, Mr. Chairman, I understand that the program of OTA fellowships, which allow experienced individuals from industry or universities to spend a year on the OTA staff, is outstanding. This program, is, of course, another mechanism to provide the depth of experience necessary for OTA's challenging assignments.

Mr. Chairman, you asked certain specific questions in your letter of invitation, and I will try to answer those. The timeliness of OTA reports has been uneven. That situation has improved somewhat, but there is still a need for the OTA management to anticipate issues and the corresponding needs of Congress. The trick here is to encourage vigorous interaction between OTA management and members of Congress, who better than anyone else can see the emerging legislative issues related to technology.

As I implied above, I find that OTA communicates well with other elements of the Government and private sector. There is some duplication of subject matter with other studies done elsewhere. However, OTA brings its own special qualities, mentioned above, to these subjects, and I believe duplication of subject does not imply duplication of content. Finally, OTA has indeed addressed key national issues. In fact, some of its reports have helped define those issues.

In summary, Mr. Chairman, it appears that OTA has matured significantly since its inception and now provides valuable input to the Congress and to others. I find many of the assessment reports to be thorough and useful even though I have occasionally taken exception to their methodology or conclusions. The challenges of world-wide technological competition, our widely-recognized need to improve innovation and productivity, and the essential education of human resources require that we break down some of the barriers and mistrust between government and industry. I believe that this objective, as well as the maintenance of balance and perspective in OTA's work, would be enhanced by increased industry membership on the Advisory Council—without question, the complex technological issues of the day necessitate that the Congress have available to it the best possible input to assist in the legislative process.

PREPARED STATEMENT OF DON E. KASH, GEORGE LYNN CROSS RESEARCH PROFESSOR OF POLITICAL SCIENCE, UNIVERSITY OF OKLAHOMA

Mr. Chairman, members of the committee, I am pleased to have the opportunity to submit testimony as a part of the first Senate Oversight hearings on the Office of

Technology Assessment. I bring two perspectives to the testimony I am offering today. For nearly twenty years, as a university professor I have been studying the federal government's use of and policy for science and technology. In 1970, I established, at the University of Oklahoma, an interdisciplinary research program specifically organized to carry out technology assessments. During the eight years that I directed that program, I had an opportunity to observe the work of OTA, and on several occasions served as either chairman or as a member of OTA advisory panels. In 1978, I left the University for three years to become the head of the division of the U.S. Geological Survey which regulates energy and mineral development on lands controlled by the federal government. The regulatory organization I headed has recently been reconstituted as the Minerals Management Service of the Department of the Interior. My perspectives then are: (1) as a public policy researcher working specifically on energy and oceans matters, and (2) as the head of a federal scientific-technical regulatory agency. In both capacities, I have had the opporunity to observe the operation of OTA and to use its products.

My testimony will focus initially on two questions. First, does OTA address a unique and needed function; and second, has OTA's work been both useful and of high quality.

I had the opportunity to appear as a witness at the first hearings investigating the OTA concept held by the House Committee on Science and Astronautics. In establishing OTA, the Congress recognized that science and technology had become powerful and dynamic forces in our society. Science and technology are instruments which the Congress uses continually to address major problems. The other side of that coin is that science and technology are major causes of change in our society, and Congress is regularly called upon to mediate that change.

Regardless of the area of technology, complexity characterizes its relationship to the social/economic/political activities of this nation. The importance of technologically driven change plus the inherent complexity of modern technology were two dominant themes in the legislative history leading to the establishment of OTA. Those factors are even more compelling today than they were in 1972. The national interest requires that Congress have its own independent body capable of sorting out scientific-technological facts, synthesizing state of art analysis and knowledge on technological developments, and presenting the social/political/economic issues resulting from those developments in policy-relevant terms. The opportunities for misunderstanding and misuse of scientific-technical information in the formulation of government policies are great. Those who have followed federal policy for science and technology over the years are acutely aware of the damage that can be done when policies are formulated based on inadequate or inaccurate information. A scientific-technical assessment organization beholden only to Congress is an essential protection against inadequate and/or inaccurate information.

Modern technology is a creation which requires the blending together and integration of expertise and experience from a wide range of scientific-technical disciplines. Only an organization which has both a diverse scientific-technical staff and quick access to the broader scientific-technical community in this country can effectively provide the Congress with a disinterested assessment of scientific-technical developments and programs. I emphasize this point because all too frequently assessments of scientific/technical programs which do not tap a broad base of expertise result in seriously flawed assessments. The genius of OTA is that it provides for the Congress both a staff with broad expertise; and through its extensive use of advisors, consultants, and temporary appointees, the ability to tap the broad, national, scientific-technical community. In summary, the OTA serves a unique and valuable function for the Congress and is well organized to carry out that function.

The next question is: how has OTA done in carrying out its mission? The quality of OTA work is good and getting better. Under the direction of John Gibbons, this improvement in quality has been particularly striking. OTA reports are widely used and they ae favorably received. They reflect balance, careful attention to detail and accuracy, and reflect a consistent pattern of relevance that is distinctive. Finally, I would note that the OTA has now evolved a report format that maximizes the usefulness of its products.

I'd like to underline my assessment of the general quality of OTA reports by referring to the technical memorandum entitled, "Coal Exports and Port Development." I recently had responsibility for leading the planning of a study for the National Research Council that is concerned with the dredging of U.S. prts. The issue of dredging has come to the National Research Council because of growing concerns about the adequacy of our ports to handle the increasing quantities of bulk goods that may be exported or imported. The most immediate factor driving this concern has been a rapid increase in coal exports. The OTA technical memorandum is easily the best, single document I have found. It organizes the issues in a very efficient way and provides information coverage that I found to be extremely useful. The memorandum on coal exports was out together in a matter of a few months and it reflects one of the very positive developments at OTA. The ability of OTA to put that report together resulted from its use of a number of studies that it had previously carried out. Clearly, the OTA is enjoying a rapid learning curve and the benefits of a growing accumulation of expertise, information, and knowledge. The issues surrounding coal exports and more broadly the adequacy of U.S. ports will almost certainly be a concern to the Congress over the next several years, and the OTA role in organizing this issue and sorting out the facts will, I am confident, turn out to be of very great value to the Congress and the nation.

Mr. Chairman, in your letter requesting my testimony, you asked three specific questions. The first of those was how timely are OTA reports? I have already noted how timely I found the one on coal exports. On a more general level, I have been impressed over the years with the regularity with which OTA reports have anticipated problems. Since OTA carries out the vast majority of its research at the request of the members or committees of Congress, I can only conclude that the members and committees have found it particularly valuable to have an organization oriented toward the anticipation of problems. In the very recent past, one can illustrate two instances in which OTA reports have been particularly timely. One of those was the report of OTA on the MX missile system and the other was the report dealing with Soviet energy availability which turned out to have special relevance to the issue of the Soviet gas pipeline to Europe. As an individual who has spent a good many years of his life seeking to identify and then investigate issues in advance of their arrival on the public agenda, I can say that OTA has an admirable record. I assume that this comes in no small part from the continuing dialogue between the OTA staff, the members and committee staffs of Congress, and the broader dialogue which OTA has with individuals and organizations in the private sector.

Your second question, Mr. Chairman, had to do with how well OTA communicates with other agencies of government. I can speak to this both as an outside observer and as a participant. I know from discussions with people in other Congressional-support organizations that continuing effort is made to assure that duplication does not occur. Based on my information, the level of cooperation between OTA and the other Congressional-support agencies has been improving markedly. OTA's relationships with the various executive agencies is not so well known to me except in the case of my own experience. In that instance, we, at the Geological Survey, found the OTA reports to be of value. We also found the OTA staff to be particularly open and helpful as we dealt with problems. If I may expand your question a bit, I'd like to address the relationship between OTA and non-governmental researchers. In this connection, I can assure you that OTA has been consistently helpful to those of us in the non-governmental research community. I am also convinced that this is a benefit to OTA because large numbers of researchers outside government are willing to provide assistance to OTA on a very rapid basis as a quid pro quo for the cooperation which OTA manifests.

Your final question, Mr. Chairman, had to do with whether OTA's assessments address key national issues. A quick perusal of the reports, either recently produced or about ready to come out from OTA, provides the answer to that question. OTA has addressed or is addressing a broad range of important issues ranging from computerized national information systems, to high-level radioactive waste, to federal coal, to the impacts of technology on agricultural production.

A more general point which underpins all three questions formulated in your letter, Mr. Chairman, concerns how well OTA has been able to walk that fine line between having some distance from the immediate day-to-day brushfire concerns of Congress; and the other extreme, dealing with such distant and abstract issues that they never have much relevance. It is clear that after swinging one way and then another over its history, OTA has now arrived at something reasonably close to the golden mean. OTA is clearly producing reports that anticipate problems. Those reports have crisp, well-organized, and accurate information, and they identify and sort the problems for Congress quite effectively. In addition, the reports reflect OTA's appreciation that it is neither a policy-making nor a policy-advocacy organization. The reports serve very usefully to flag the issues and organize the information for the consideration of Congress and the broader policy community.

Finally, Mr. Chairman, I'd like to add one point. OTA has been distinctly successful in building a network of consultants and advisors which runs across the spectrum from industry through state government and various interest groups to the universities, and which covers the whole spectrum of scientific-technical expertise. The quality of people who serve as OTA advisors, consultants, and panel members is distinctly high. I have on occasion thought that I would like to be able to construct a university from the cast of advisors and consultants to OTA. It would certainly be a first-rate institution.

As my preceding remarks indicate, I am very positively impressed with the skill OTA has manifested in carrying out its responsibilities to Congress. I believe that Congress has a present need and will continue to have a need for the kind of scientific-technical assessment and support which OTA provides. Although one can never quantify the benefits of an OTA, I am personally convinced that OTA has saved the taxpayers multiples of what it costs and has contributed to a better informed public policy in this country.

Mr. Chairman, I thank you for this opportunity to submit testimony.

PREPARED STATEMENT OF DR. JAMES C. FLETCHER

I was pleased to receive an invitation to submit testimony to the Senate Rules Committee on the occasion of its oversight hearings on OTA. As one who has served nearly four years on the Technology Assessment Advisory Council of OTA and whose professional life has been divided between government (NASA), the corporate world (Burroughs Corporation), and academe (University of Pittsburgh), I feel well-equipped to comment on OTA.

With that in mind, let me offer the following comments:

1. The combination of complexity of subject and relative degree of comprehensiveness that OTA attempts in its analyses are extremely difficult undertakings. Effective interweaving of different disciplines is required and often the "facts" are so unclear that technical consensus must be utilized.

As a former senior manager in NASA's space effort, I know the critical role of technical research and information as a basis for action. Problems OTA deals with are in a real sense more difficult than NASA's because data are less definitive and variables more diverse and greater in number. Consequently, the methods of analysis and range of disciple applied are more extensive than in a purely hardware program—no matter how complex.

2. As a member of various OTA Project Advisory Panels, I have observed with interest how OTA draws upon external expertise. The methods OTA uses give it high leverage with its resources. It gathers no more primary data than is absolutely necessary. It makes diverse but highly judicious use of temporary employees, contractors, consultants to tap the best experts on a subject under study, but is able to shift its professional expertise fairly quickly. In fact the interplay of staff, contractors and Senior Advisory Councils is as well done as any other analytical agency either within or outside government. It is perhaps this uniqueness that makes the demand for OTA reports so high.

3. OTA's use of Project Advisory Panels, and extensive internal and external review processes ensure that it takes full advantage of existing information—whether from the literature or from current work in government, industry, or university. In its assessment of Solar Power Satellites, OTA utilized and went beyond previous analyses by NASA, DOE, and the National Research Council (of the Academies of Science).

As Vice Chairman of DOE's Energy Research Advisory Board, I found that OTA reports were invaluable, in fact several were used as the basis for setting R & D priorities in the first attempt (1981) in setting these priorities in a systematic way. Also as a member of the Defense Science Board, I found that the study of MX basing options was the broadest, least biased of any report made on this problem and I believe was invaluable to the Townes Panel in its initial deliberations.

4. Congress and the public need a resource group capable of addressing controversial issues in technology policy in a highly professional but nonpartisan way, capturing the best possible national wisdom. The output provided by OTA: a presentation of options—not prescriptions—is very appropriate.

As now constituted, OTA is neither a hotbed of technology enthusiasts nor a group of people focused on the unhappy side of technology's impacts. Rather, they are a small, skilled, and remarkably diverse group of scientists, engineers, doctors, lawyers, economists, and social scientists who believe that technological innovation is the key to the nation's future policy options. They also understand that while there is no "free lunch", there are various costs for lunch.

5. OTA is increasingly active in delivery of information on current topics; yet it must also commit substantial resources to thinking carefully about the future. OTA is capable of becoming much more active in its latter role in performing the kind of careful and dispassionate analysis needed to map out a clearer picture of the differ-

ent paths we may take in the future, the options available to us, and the implications for policy choice.

6. OTA makes remarkably effective use of the resources at its disposal. It should be said, however, that those resources are uncomfortably small compared to the scope of OTA's responsibilities. In fact if I were to cite one principal weakness in OTA it is inadequate funding. Many important studies have to be abandoned or discarded before initiation because of insufficient funds. Programs that are approved tend to be ones that are most strongly supported by Congress but longer range, broader-look studies envisioned by OTA internal staffers tend to fall into the class of lower priorities. If there is any place within the Legislative Branch where longer range studies ought to be undertaken, it is within OTA. Even with NASA, this has been difficult but within OTA it's almost impossible, partly because of insufficient funds and partly because of the prioritization process within OTA and the TAB.

7. In summary, the evidence shows that OTA is functioning as well as the optimists have hoped, its resources are being used in a highly productive way, and is delivering highly valuable services to Congress and the Nation. In the face of growing intensity of science and technology issues, it merits considerably more support. Additional attention should be given to the amount of "foresight" analysis done at OTA. The unusually extensive involvement of outsiders in OTA's work is a key to its success because it enables OTA, as a shared resource of the Congress, to truly be the gathering place, the catalyst, for national wisdom about issues of great national consequences.

Prepared Statement of Dr. Charles N. Kimball, Midwest Research Institute, Kansas City, Missouri

I am delighted that the Senate Committee on Rules has initiated oversight hearings on the Office of Technology Assessment and am pleased to submit this testimony for your consideration.

PERSPECTIVE

It may be helpful to the Committee if I indicate the basis for my comments on OTA. As first a Member and now as Chairman of OTA's Technology Assessment Advisory Council (TAAC), I have been in a position to closely observe the performance of the Office. The TAAC was created by statute as an expert body to advise OTA and to monitor the activities of the Office on behalf of OTA's Congressional Board. Permit me to submit for the record a text of OTA's statute regarding TAAC and the current membership of the Council.

I am trained in science with a doctorate from Harvard University in communications engineering (1934), and served for 25 years as chief executive officer of The Midwest Research Institute, one of the large independent research institutes in the country. Consequently, the world of science, technology, and policy research is quite familiar to me. I have also served on the Board of Directors of two major corporations, TransWorld Airlines and Hallmark Cards, Inc., and as a trustee of several foundations as well as the Committee on Economic Development. From these vantage points certain observations, in particular, strike me about OTA.

PRODUCTIVITY

At a time when the productivity of government institutions is being widely—and rightly—scrutinized, OTA has proven to be an extraordinarily productive place. Few other institutions, public or private, could, with the size staff at OTA, turn out annually two dozen book-length studies of exceptional quality and comprehensiveness on very complex issues. And OTA's output of analysis, testimony, and briefings encompasses a great deal beyond the full assessment reports.

The reasons for this achievement lie in the character of staff, its realization that the issues being analyzed are truly important, and the stimulation that results from the staff's extensive interaction with experts and representatives of major interests from around the nation. The result is a healthy competitive testing and sharing of information and ideas. In other words, OTA's method of operation daily thrusts its staff into interaction with people all around government and, most importantly, outside government in industry and universities.

BRIDGE BUILDING

My colleagues in the private sector increasingly value and respect OTA as one place they can get a hearing for their views that is both fair and knowledgeable.

Channels of access to or communication with the Congress that are relatively free of bias and that can transmit complex technical material accurately are rare. OTA is such a channel—perhaps a unique one. Similarly, OTA serves as an arena for nonadversarial problem resolution when different interests and experts tackle a common problem.

Such recent OTA assessments as those on nuclear waste, oceanographic research, agricultural research and development, and Soviet energy illustrate OTA's ability to provide a unique institutional setting that has credibility with all the contesting parties on a highly disputed issue. This is particularly important if we are entering a period when government and business must reassess the adversary climate that has often characterized their relationship as well as consider how the two sectors can work together more constructively. OTA constitutes a "meeting ground" of proven value and much promise in that effort.

COMMUNICATION

The influence of science and technology upon our lives becomes more pervasive as each day passes, yet only a relatively small percentage of the American people have the technical background to really gain an understanding of this ubiquitous, dynamic force. In fact, science and technology are the subject of distrust and fear by a large number of people who, while they are not equipped to understand, yet know that their future lifestyle and livelihood will be profoundly shaped by technological change. The result is a growing gap of confidence between a sort of technological elite and the rest of the populace.

Such a situation is neither healthy or even sustainable in a democracy. OTA has a crucial role to play in narrowing the gap, not only between those dealing with technological issues in government and industry, but also between the technical specialists and the informed layman—policymaker and concerned citizen. In my judgment, OTA is doing an exceptional job of integrating technological information into accurate but understandable terms. The fact that its work is being widely reprinted in the commercial sector, not only in the U.S. but in several foreign countries, is indicative of the broad interest in these Congressional studies. That communications effort deserves every encouragement. The great American democratic experiment will be in serious trouble if the average citizen is not equipped to make an informed judgment on the issues that shape the nation's future.

Finally, let me return to the matter of the importance of the issues that OTA typically addresses by citing two specific instances. In the Midwest, we are understandably preoccupied with the agricultural economy. As we look to the future, we are increasingly concerned about the viability of the soil and water resource base that sustains Midwestern agriculture and provides the nation with a large measure of its export commodities. Already we know that the vast fresh water aquifers that underlie the Great Plains and supply the water used for irrigation are being depleted at a rapid rate. Financial institutions are even beginning to worry about long-term mortgages in the light of an uncertain future for water and the future implications for the region's economy. Exactly how serious is the problem? What can be done about it? How and at what cost?

In a different but related sense, we need to know whether we are depleting our soil with present farming practices. If so, is the process reversible? How dependent are our options on the long-term availability of relatively low cost fertilizer and fuel from fossil resources? How much time do we have? These are serious questions. Much rides on the answers and those answers are not obvious. OTA is presently addressing both questions with vigor.

Different aspects of complex problems such as these are under study by a wide range of organizations. The more important the issue, the more likely this is to be the case. As this process proceeds, however, it becomes increasingly difficult to intergrate across the multiplicity of actors, perspectives, and specialized studies. OTA has a unique role to play as a place that can communicate with the disparate interests involved, pull diverse information together, separate the wheat from the chaff, and provide a bottom line of policy options available to the Congress. All this must be done with sufficient foresight to provide time for policymakers to act before their backs are against the proverbial wall.

Let me conclude by reiterating that in OTA you have a remarkable instrument. I can only encourage you to make full use of it. It is an institution of what the Senate can be proud.

ESTABLISHMENT OF THE TECHNOLOGY ASSESSMENT ADVISORY COUNCIL

Sec. 7 (a). The Office shall establish a Technology Assessment Advisory Council (hereinafter referred to as the "Council"). The Council shall be composed of the following twelve members:

(1) ten members from the public, to be appointed by the Board, who shall be persons eminent in one or more fields of the physical, biological, or social sciences or engineering or experienced in the administration of technological activities, or who may be judged qualified on the basis of contributions made to educational or public activities;

(2) the Comptroller General; and

(3) the Director of the Congressional Research Service of the Liberty of Congress.

(b) The Council, upon request by the Board, shall——

(1) review and make recommendations to the Board on activities undertaken by the Office or on the initiation thereof in accordance with section 3(d);

(2) review and make recommendations to the Board on the findings of any assessment made by or for the Office; and

(3) undertake such additional related tasks as the Board may direct.

(c) The Council by majority vote, shall elect from its members appointed under subsection (a)(1) of this section a Chairman and a Vice Chairman, who shall serve for such time and under such conditions as the Council may prescribe. In the absence of the Chairman, or in the event of his incapacity, the Vice Chairman shall act as Chairman.

(d) The term of office of each member of the Council appointed under subsection (a)(1) shall be four years except that any such member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed for the remainder of such term. No person shall be appointed a member of the Council under subsection (a)(1) more than twice. Terms of the members appointed under subsection (a)(1) shall be staggered so as to establish a rotating membership according to such method as the Board may devise.

TECHNOLOGY ASSESSMENT ADVISORY COUNCIL

Dr. Charles N. Kimball (Chairman), President Emeritus, Midwest Research Institute.

Dr. Jerome B. Wiesner (Vice Chairman), Former President, Massachusetts Institute of Technology (MIT).

Professor Earl H. Beistline, Dean, School of Mineral Industry, University of Alaska.

Dr. Claire T. Dedrick, Member, California Air Resources Board.

Dr. James C. Fletcher, William K. Whiteford Professor of Technology and Energy Resources, University of Pittsburgh (former Administrator, NASA).

Mr. S. David Freeman, Board of Directors, Tennessee Valley Authority.

Professor Carl N. Hodges, Director, Environmental Research Lab., University of Arizona.

Dr. Rachel McCulloch, Department of Economics, University of Wisconsin.

Dr. Frederick C. Robbins, President, Institute of Medicine.

Dr. Lewis Thomas, President, Memorial Sloan-Kettering Cancer Center.

Statutory Members

The Honorable Charles A. Bowsher, Comptroller General of the U.S

The Honorable Gilbert Gude, Director, Congressional Research Service, Library of Congress.

The CHAIRMAN. I think the committee will appreciate the thoughtful comments and suggestions that have been made this morning, both in open testimony and in the statements submitted for the record.

I think moving beyond the area of technology assessment, the committee will hold additional hearings during the year on the other legislative branch support agencies. We will start with the Library of Congress and the Congressional Research Service, and we will go on to the General Accounting Office and the Government Printing Office and the Congressional Budget Office, so that we will be in a position to report on these hearings and the findings that are derived from them to the Senate, and, if, as, and when necessary, any recommendations for further legislation.

So, Dr. Gibbons, unless you have something further to add at this time, we will stand adjourned, subject to the call of the Chair.

[Statements and other materials subsequently submitted for the record follows:]

PREPARED STATEMENT OF DR. JEROME WIESNER

I understand that there is currently some confusion about the necessity of the Office of Technology Assessment in the Congressional advisory system. My experience as a member of the Technology Assessment Advisory Council since OTA's inception, and as Chairman or Vice Chairman of the Council for more than half this period, allows me to address this matter with first-hand knowledge. Let me briefly review for the record the important and unique functions that OTA performs for the Congress.

It is imperative that Congress have the best possible sources of information and analysis on tap in order to make the difficult decisions which it faces, particularly in this era of increasingly austere budgets. Close to a decade ago, various members of Congress and a number of concerned individuals, such as myself, were disturbed by the lack of any source of long-term analysis on potential consequences of technological applications. Thus, when the Office of Technology Assessment was created in 1972, the goal was to provide an "early warning system" to alert the Congress to potentially troublesome or dangerous but unforeseen consequences of the applications of technology. This task was not being performed by any unit of the society, but was one whose importance took on increasing magnitude as the nation encountered one upsetting and threatening technological surprise after another.

Yet, as soon as it began to function, OTA acquired a second, equally necessary and pressing task to provide the Congress with technical assistance on policy matters involving science and technology. The impact of scientific and technological innovation has taken on ever-increasing dimensions throughout our society. There has been a concomitant growth in the importance of technology as a crucial component in policy creation. The Congress, however, had no source of objective, non-partisan scientific and technological expertise and analysis to tap for such matters. The executive branch, on the other hand, had long ago established and continued to build upon a wealth of in-house scientific and technological expertise though inevitably their analysis tended to be self-serving. This second function of the OTA thus soon became the larger one for the OTA staff, as Congress used it to fill this long-standing and critical vacuum.

The importance of both the "early warning" and technical assistance functions of the OTA has increased, proportional to the increasing scale and complexity of technology itself. These functions shall continue to grow in significance to the Congress in the years ahead.

After a difficult start-up period, OTA has blossomed to maturity under its third and latest director, Dr. John Gibbons. With his direction, OTA has become a streamlined, highly efficient and flexible organization, uniquely responsive to the science and technology needs of Congress. With superb leadership and its dynamic interaction with the legislative process, OTA has been able to attract an outstanding set of highly trained professionals, ranging from biochemists and telecommunication experts, from economists to systems analysts.

OTA's small size, expert staff, and clear focus on science and technology have allowed it to perform in ways which larger agencies with very broad mandates cannot. It has been particularly successful in forging strong links with scientific and technical experts in the academic and business communities, as well as with qualified individuals in other state and federal offices and agencies. Other such links are created through the interests and activities of OTA's Technology Assessment Advisory Council. Thus, for any new study of a major technological application, OTA is able to tap a nationwide network of individuals with scientific and technological expertise as needed, giving an opportunity for a wide range of interests to be synthesized for the Congress. Through this process, OTA has become a highly regarded entity in the technical community, reflected for example, by the number of its reports which have become basic documents on their subjects.

OTA fills another important role, not often articulated. It provides a special, highly visible focal point for science and technology matters, the many ways in which applications of technology can have immense impact on the lives of Americans, and thus the wide implications of policy decisions involving science and technology.

The development of OTA has been difficult, because it had to learn how to do technological assessments; it had to learn how to provide reliable analysis on the difficult time schedules with which Congress is forced to work; it had to learn how to balance the use of permanent staff verus consultants and panels; and, it had to learn how to work in the complex environment of the legislative branch of government.

From my vantage point, it appears that the OTA deals well with all these problems now, and has achieved a position of accomplishment and acceptance which should make it an evergrowing asset for the Congress and for the nation.

NATIONAL ACADEMY OF SCIENCES,
Washington, D.C., February 17, 1982.

Hon. CHARLES McC. MATHIAS, Jr.,
Chairman, Committee on Rules and Administration,
U.S. Senate, Washington, D.C.

DEAR MR. CHAIRMAN: This is in response to your invitation to testify on February 5, at the first oversight hearings by the Senate Committee on Rules and Administration on the Office of Technology Assessment (OTA). I regret that my absence from Washington prevented my appearance as a witness; however, I am pleased to present for the record this statement on the subject of your hearings.

As you are aware, the concept for a Congressional Office of Technology Assessment emerged in part from a series of studies undertaken in the late 1960's on behalf of the Congress by the National Academy of Sciences and the National Academy of Engineering. These studies were to assist the Congress in exploring the development of institutional mechanisms and programs for technological assessment that could serve both the legislative and the executive branches of Government.

The concept of technology assessment arose in an era of growing concerns about the social and physical side effects and stresses arising from the uses of emerging technologies. Simply stated, technology assessment was to provide a means for better understanding and evaluating the consequences of these uses. While these concerns seem more muted today, there remains a residual and constructive perception of technology as a force from which both benefit and injury to mankind may flow.

As conceived, the institutional approach to technology assessment was the creation of a new mechanism that would introduce a greater degree of objectivity into the process of problem solving and inject a body of criteria and assumptions that could reflect a broader set of interests and values than did specialized organizations engaged in fragmented assessment activities. This same criteria was seen as applying not only to the executive branch of Government but as well to the legislative branch where the committee system reflects a distinct fragmentation of interests.

The Academy's report to the Congress in 1969 outlined the purposes for which such an institutional arrangement should be devised. It should:

"Provide, within or close to the Congress, an effective public forum for responsible assessment activities of individuals or groups operating outside the present governmental and industrial technology-assessment apparatus.

"Allow the Congress effectively to utilize the input of data, complaints, and suggestions pertinent to technological development or its consequences that may be expected to flow from the general public, in part spontaneously and in part under stimulus.

"Enable the Congress to make constructive and systematic use of existing assessment systems in the government, with special emphasis on the identification of gaps in information and analysis with respect to on-going or proposed federal programs directly influencing major technological applications.

"Enhance the comprehensiveness and competence of technology-assessment activities engaged in by the staffs of congressional committees or by other groups responding to requests from members of Congress, by developing in Congress a greater capacity to mobilize independent professional resources to assist it in technology-assessment tasks.

"Strengthen the ability of Congress critically to review findings, recommendations, and decisions potentially bearing on federal policy with respect to technology, whether made by existing executive departments and agencies, or embodied in the reports of the proposed addition to the Office of Science and Technology, or reflected in studies submitted to the proposed Technology Assessment Division of the National Science Foundation.

"Equip Congress with a mechanism for generating conclusions of its own bearing on technology-assessment issues and priorities, supported by a systematic search of current professional literature and by continuing contacts with professional groups."

My understanding of the current support and operational relationship between OTA and the Congress indicates that these purposes are being well served.

The course of OTA's evolution from its 1972 beginning has been one of continuing adjustment in its operational mode as better means are sought for serving the needs of Congress. This historical growth has witnessed the emergence of a unique and significant resource available to the Congress for undertaking assessment analysis. In fact, the scope of the assessment programs now being initiated on behalf of the committees of the House and the Senate provides a comprehensive mechanism for analysis that is not found elsewhere in the Government, either in the executive or legislative branch. Certainly the increasing utilization of OTA by committees in the House and Senate illustrates a growing recognition and acceptance of its value in the legislative process.

A number of project study areas covered in OTA's current program are similar to analytical studies undertaken by the National Research Council. As you man know, the National Academy of Sciences, and its National Research Council, also was created by the Congress as an institutional mechanism to advise the Government on matters of science and technology. There are a number of similarities in the operational methods employed by the Academy and OTA.

OTA, like the Academy, calls upon the technical skills and resources of individual experts from the public and private sectors, thus bringing to bear on a particular issue a wide range of individual interests and the best technological resources of this nation. The practice of using *ad hoc* advisory groups and consultants, as support to its small in-house staff of professionals, also gives to OTA the flexibility to bring in individuals with new perspectives and to stay in continual contact with changes in the state-of-the-art that are taking place in industry, universities, private research organizations, and public interest groups. From the vantage point of this familiarity with the kinds of issues that OTA addresses, I give high marks to many of the more recent study reports that OTA has issued. I would like to associate myself with the remarks before your Committee by Dr. Frederick Robbins, President of the Institute of Medicine, a major component of the National Academy complex, that "the products of OTA have been of high quality and some truly outstanding."

In responding to your specific question as to whether key national issues are reflected in assessments requested of OTA, there is no question that the current program agenda of OTA is relevant to many of the more significant public policy issues of today, e.g. How we dispose of industrial hazardous waste? What is the impact of technology on competitiveness of U.S. industry? Are there better means for applying medical technology to the needs of the handicapped? How do we develop a better understanding of the societal impact of telecommunications technology? What are the nature and extent of the impact of atmospheric alteration, etc.? Certainly these issues define significant aspects of any national agenda for the 1980's.

In closing, I would urge that the Congress be ever alert to the need for maintaining OTA's role as an objective and unbiased assessment support resource. Every effort should be made to avoid the creation of an oversight decision making role for OTA with respect to Congressional review responsibilities over executive branch agencies. This is a responsibility that, in my view, must remain lodged in the committees of the House and the Senate, or other legislative agencies created to serve the Congress to meet these purposes, e.g., the General Accounting Office.

To assign such responsibility to OTA could seriously erode its impartiality and credibility. Congressional confidence in the assessment role of OTA is dependent upon this impartiality and upon its reputation for competent professional analytical skill, a posture which OTA has carefully attempted to construct and maintain.

I appreciate the opportunity afforded me to offer these comments on the assessment support role provided to the Congress by OTA. Having established its capability for service to the Congress, I personally look with confidence upon the future contributions of OTA as a significant national resource for coping with emerging problems of technology.

Yours sincerely,

FRANK PRESS, *President.*

RESOURCES FOR THE FUTURE,
Washington, D.C., February 3, 1982.

Hon. CHARLES McC. MATHIAS, Jr.,
Chairman, Committee on Rules and Administration, U.S. Senate, Russell Senate Office Building, Washington, D.C.

DEAR SENATOR MATHIAS: Inasmuch as my staff and I have worked with the Office of Technology Assessment over the years and have come to regard it as a highly competent and useful organization, I want to convey my impressions as you and your colleagues prepare to exercise your oversight responsibilities for OTA. What follows is anecdotal, judgmental, and suggestive rather than definitive, but it does illustrate some of our experience with OTA and I hope you will find it helpful in your review.

To begin even before the beginning, one of our senior staff members, Hans Landsberg, was a member of the National Academy of Sciences panel that recommended the establishment of an Office of Technology Assessment, and he is very satisfied with the product. Importantly, his assessment is that of one who has worked closely with OTA. He currently is chairman of one of the two advisory committees examining the trade-offs between improved auto efficiency and synthetic fuel production. This study, which will be released soon, will be very useful, in Mr. Landsberg's opinion.

Mr. Landsberg also participated in the study, Management of Fuel and Nonfuel Minerals in Federal Land, published in April 1979, which he regards as an especially good piece of work. He bases his opinion not only on the inherent value of the report, but also on the foresight involved in guessing correctly that the issue itself would move to the national front burner. As one who is intimately involved in the setting of a research agenda, I can assure you that this sort of prescience is exceptional.

Other staff members—particularly those concerned with energy issues—have been active in OTA studies. For example, Joel Darmstadter was a member of the advisory panel for Residential Energy Conservation, published in 1979, and for some three to four years participated in briefings and study groups on other energy policy questions. And Harry Perry, a consultant in residence here, was chairman of OTA's Advisory Board on Direct Utilization of Coal, among other activities.

On the executive level, my predecessor, Charles J. Hitch, participated on OTA's Panel on Applications of Science and Technology a few years ago, and I just recently was consulted in the study which led to the publication of Assessment of the United States Food and Agricultural Research System. And soon after taking office, OTA Director John Gibbons visited us and addressed our staff on his new responsibilities and plans.

In brief, our judgment is based on long and fairly close association with OTA, and we conclude that its staff is competent, its leadership under Dr. Gibbons is excellent, that it does full justice to complex issues, and that it performs a very useful function in focusing research issues for Congress. I should say that OTA is especially effective when it draws on work done here at Resources for the Future and other such organizations, and is less so when it is asked to perform basic original research in a short time frame. This is not so much a criticism—indeed, few if any research organizations can produce "solutions" on demand—as it is a suggestion that Congress capitalize on OTA's strengths and refrain from requesting what it cannot deliver.

I would be pleased to discuss OTA with you and your colleagues, if you wish. After early instability it has developed into a fine organization that we hope will continue to be supported by those whom it serves.

Sincerely yours,

EMERY N. CASTLE.

DEPARTMENT OF NUCLEAR ENGINEERING,
MASSACHUSETTS INSTITUTE OF TECHNOLOGY,
Cambridge, Mass., February 16, 1982.

Senator CHARLES McC. MATHIAS, Jr.,
Chairman, Committee on Rules and Administration, Russell Senate Office Building, Washington, D.C.

DEAR SENATOR MATHIAS: It is a pleasure to write to you about the Congressional Office of Technology Assessment, the subject of present oversight hearings by your Committee on Rules and Administration. Under its former and especially its current leadership, OTA has built an outstanding reputation both in the Federal Government and in the world at large, for the quality of its technical work and for preparing material well designed for public policy decisions.

I have been following OTA's progress since before its formal inception, starting with the insightful proposals made in 1968–70 by then-representative Emilio Daddario, later to become OTA's Founding Director. At about that time, I was seeking new roles along that line as Director of Long-Range Planning of the Oak Ridge National Laboratory, and also here at MIT, where Emilio Daddario and I shared a seminar course one term, dealing with these topics. Since 1974, I have been an occasional consultant to OTA, and collaborated in its energy assessment (particularly) since the very beginning.

The period 1968–72, encompassing the time when I was at the Oak Ridge National Laboratory and where I came to know and respect the abilities of Jack Gibbons, OTA's present Director, was a critical time for technology assessment. Phrased as the task of thinking better about what to do in the future, it was an old art; but rapidly changing technological, social and administrative circumstances, and the awareness of environmental and energy problems (the latter being visible even then) made technology assessment an ever-new thing. Something needed to be done.

How should or could the Federal Government respond? The Executive Branch, via actions of the Office of Science and Technology, via some of the National Science Foundation's work and some other routes, tried its hand, leading to increased awareness and permanent improvement. But the Executive Branch tends naturally to focus its attention on organizing around perceived best courses; facing paradox and conflicting goals, things that appear centrally in technology assessment come less naturally to the Executive Branch than to the Congress. Thus it was, for example, that a proposal made in 1970 by a number of us, including Jack Gibbons, to incorporate extensive assessment activities into the National Laboratories was supported less enthusiastically by the Executive Branch than it was by the Congress—especially by Senators Baker and Muskie.

Thus with the primary effort of Emilio Daddario but with many other supporting activities, OTA came into existence in 1972, and it has turned out well. To be sure, the Congress still gets most of its information and advice from the Executive Branch and from a myriad of other places, but something was inadequate about almost all of them, especially in matters involving complex technological choices. The Congress needed help to illuminate evenly and clearly the available option space, so to speak. But now the facts of organizational life that I referred to only a paragraph ago created difficulties. Most of those non-Congressional groups—Executive Branch or elsewhere—had already done their own assessment, to be sure with every good intention, but you in the Congress had no way of seeing inside it. Thus the Congress was too often presented with just one option, with an inordinately heavy freight of support.

I recall discussions in OTA's early days about how it should go about its work. The Office has, in its mixture of in-house, consultants, and contracted outside studies, developed a very good way of operating. Hazards of imbalance exist on all sides. On the one hand, some Agencies contract out too much and have insufficient inhouse expertise (or don't use well enough what they have) either to know truly what they seek, or to assess what they get. Thus they find themselves at the mercy of other groups that have a past to defend, a present to support, or a future to prepare for. On the other hand, all in-house would for OTA: (1) be impossible; (2) even if possible, stifle innovation and lively contributions from outside. A requirement for following a middle road successfully is to have a very competent OTA staff, capable of: (1) reaching out to collect the best outside work; (2) doing its own work in-house and assessing all the options as well as if it had done all the work itself; (3) translating all this into a form suitable to Congressional needs, in several levels of detail.

OTA has been more successful at all this than any other group anywhere else, and the visible evidence is before you. Consider the quality of its reports, that come in at least three levels of complexity, each complete in itself: brief but meaningful abstracts, assessment summaries, and full reports. Consider also the ability of OTA to attract top-flight people to help with its work, on advisory panels and in other capacities; they see themselves as part of a first-class team effort, and see that the OTA products are important, useful, and really used. A positive reinforcement works here—good attracts good. Other countries, seeing its success here, now set up OTA-like groups in their own governments.

I use OTA reports in my energy course at MIT: on coal ports, solar power satellites, technology and Soviet energy availability, and nuclear power standardization, for example. I also teach about technology assessment itself; OTA's MX missile siting report is an outstanding example. It showed that all the suggested options had substantial difficulties and some had fatal flaws: it showed that the Department of Defense's analyses had been dismayingly flimsy; it showed the value of good assessments in saving the country many billions of dollars.

In the late 1970's I was also a consultant to Elmer Staats and developed great respect for his work in finding new useful roles for the GAO. The OTA, CBO, CRS, and GAO each have reinforcing tasks in making assessments for the Congress: the CBO mainly financially, the CRS mainly on short-term and more specific items needed by the Congress, and the GAO mainly (but not exclusively) retrospectively. OTA, like the Roman god Janus, looks both backward and forward in time as it fulfills its unique role of illuminating the technological future. I know people in each of those four Congressional support groups, and assure you that they work well together, without redundancy.

The Congress is to be congratulated for setting up and supporting such a successful Office.

Yours sincerely,

DAVID J. ROSE, *Professor.*

AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS,
New York, N.Y., February 5, 1982.

Hon. CHARLES McC. MATHIAS, Jr.,
Chairman, Committee on Rules and Administration,
U.S. Senate, Washington, D.C.

DEAR SENATOR MATHIAS: As one who has been associated with a number of OTA projects, I am pleased to provide my views on the manner in which the Office serves the needs of Congress.

My involvement with OTA has been as an advisory committee member in four areas: energy (I was Chairman of the Solar Advisory Panel for several years, and also served on a number of other energy panels), research and development, transportation (aviation), and space.

I believe that OTA provides a vital service to the Congress in this day of ever-increasing technological impact on the quality of life and on the nation's legislative activities. Although there have been some ups and downs in the fulfillment of that function since OTA was first formed, the Office has now attained a mature level of competence and is indeed serving the Congress as its founders intended it to.

My closest associations with OTA have, of course, been in connection with the assessments in which I participated directly. However, I also read and used a number of OTA's other publications in those subject areas which were of direct interest to me. The overall quality of these documents has been extremely high, and Congress has every right to be gratified by OTA's performance in producing them, and in advising Members of their results.

The mechanism by which OTA generates its studies has matured along with the Office itself. The practice of using Advisory Panels composed of qualified representatives of all sectors concerned in the subject to advise the OTA staff and its contractors and to review their work in depth has proved to be an effective means for assuring both the technical excellence and the breadth of coverage Congress needs in order to make properly informed decisions. Over the years, OTA has built up an impressively competent staff and a truly eclectic roster of potential advisory panel candidates.

The process by which OTA selects its projects could, perhaps, bear some study. Assessments should, of course, continue to be performed primarily when solicited by Congressional committees, and it is clearly a proper function of the Technology Assessment Board (TAB) to decide among those solicitations with the aid of staff analyses. However, the occasional need for studies requiring relatively fast response should be recognized as an important and growing aspect of OTA's services, I believe the Technology Assessment Advisory Committee (TAAC) could play a more significant role in helping to strengthen this function, not only in its function of reviewing the staff's recommendations for such studies and advising TAB accordingly, but also by suggesting to the staff subject areas appropriate for timely studies by the Office, subject, of course, to TAB approval.

I appreciate this opportunity to express my views on OTA, and will be pleased to answer any questons you may have or to provide whatever further information I can upon your request.

Sincerely yours,

JERRY GREY,
Institute Consultant.

BIOGRAPHY BRIEF FOR DR. JERRY GREY

Dr. Jerry Grey received his Bachelor's degree in Mechanical Engineering and his Master's in Engineering Physics from Cornell University; his PhD in Aeronautics and Mathematics from the California Institute of Technology.

His early career included stints as a full-time Instructor of Thermodynamics at Cornell, an engine development engineer at Fairchild, a Senior Engineer at Marquardt, and a hypersonic aerodynamicist at the GALCIT 5-inch Hypersonic Wind Tunnel. He was a professor in Princeton University's Department of Aerospace and Mechanical Sciences for 15 years, where he taught courses in fluid mechanics, propulsion, and nuclear powerplants and served as Director of the Nuclear Propulsion Research Laboratory. He formed the Greyrad Corporation in 1959 and was its full-time President from 1976 to 1971. He is now senior consultant on Public Policy for the American Institute of Aeronautics and Astronautics and Deputy Secretary General of the United Nations Second Conference on the Exploration and Peaceful Uses of Outer Space. He is also Adjunct Professor of Environmental Science at Long Island University, where he teaches courses on energy, Chairman of the Calprobe Corporation, a supplier of high-temperature instrumentation based on Dr. Grey's patents, and a Director of the Applied Solar Energy Corporation.

Dr. Grey is the author of seven books and over two hundred technical papers in the fields of solar energy, fluid dynamics, heat transfer, rocket and aircraft propulsion and power, plasma diagnostics, instrumentation, and the applications of technology. He has served as consultant to the U.S. Congress (as Chairman of the Office of Technology Assessment's Solar Advisory Panel), the United Nations, NASA, the Department of Energy, and the U.S. Air Force, as well as over twenty industrial organizations and laboratories. He was Vice President Publications of the AIAA for five years and Chairman of the Coordinating Committee on Energy of the American Association of Engineering Societies. He is currently Vice President of the International Astronautical Federation, a Director of the American Astronautical Society, a Director of the Scientists Institute for Public Information, and a member of the Explorer's Club. Dr. Grey is listed in Who's Who in America, American Men of Science, Who's Who in Aviation, Engineers of Distinction, Contemporary Authors, and the United Kingdom's Blue Book and Dictionary of International Biography, and is member of the International Academy of Astronautics. His most recent book, Enterprise, was published by William Morrow and Company in 1979; his next book Beachheads in Space, will be released by MacMillan in 1982.

THE GEORGE WASHINGTON UNIVERSITY,
Washington, D.C., February 10, 1982.

Senator CHARLES McC. MATHIAS, Jr.,
Chairman, Committee on Rules and Administration,
U.S. Senate, Washington, D.C.

DEAR SENATOR MATHIAS: I was pleased to attend the Oversight Hearings on the Office of Technology Assessment last Friday, February 5, since I have been an interested observer of OTA since its establishment in 1972. The testimony indicated that OTA has been most competent in carrying out its demanding, difficult and delicate tasks. While any activity involving the identification of policy options and projecting impacts into the future is eminently susceptible to "second-guessing," it seems most likely that the capacity of OTA to serve the analytical needs of the Congress on highly technical legislation will continue to improve.

Hopefully, the committees of the Congress will increasingly recognize the unique assessment resource OTA affords and will use it to the fullest practicable extent. A further point should not be overlooked—that while the primary responsibility of OTA is to clarify policy issues for the Congress, this Office also serves as a guide and stimulant to the many other public and private entities throughout the country engaged in similar efforts which assist the Congress and many other agencies of the Government.

With highest regards,

LOUIS H. MAYO,
Professor of Law and Director of the Program
of Policy Studies in Science and Technology.

WASHINGTON, D.C., *February 16, 1982.*

Hon. CHARLES McC. MATHIAS, Jr.,
U.S. Senate,
Russell Senate Office Building, Washington, D.C

DEAR SENATOR MATHIAS: We understand that you will be conducting oversight hearings on the Office of Technology Assessment. We therefore would like to take this opportunity to inform you of our very high regard for the work done by OTA and of our belief that OTA serves a variety of essential functions that should be continued and expanded.

OTA's studies in the resource and environment area have addressed key issues and have been of the highest quality. For example, its report last year on "Technologies for Determining Cancer Risks from the Environment" is the best summary and analysis that has been done of the difficult issues that arise in linking cancer and environmental factors. The assessment of oil shale technologies, issued last year, was the most direct and authoritative examination of some of the problems of oil shale development that has been published. OTA's work on pest management strategies is the most valuable and comprehensive work available on the subject.

We could expand the list of examples at some length. OTA's work is not only superior to that of any other arm of Congress, it is at the present time far superior to what is coming from the executive branch agencies in terms of the importance of the subjects addressed, the depth of the analysis, and the accuracy of the information. Congress had long needed on office that could perform in-depth analyses using a combination of skilled in-house staff and outside contractors. OTA has, in our opinion, fulfilled this need admirably.

We hope that this information is helpful to you.

Sincerely,

WILLIAM K. REILLY, *President.*

LIBERTY LOBBY,
Washington, D.C., February 10, 1982.

Senator CHARLES McC. MATHIAS, Jr.,
Chairman, Senate Rules Committee,
Washington, D.C.

DEAR SENATOR MATHIAS: Liberty Lobby Inc. is an organization of patriotic citizens determined to preserve America as a nation truly "of the people, by the people, and for the people." If our government is to be responsive to America's needs, it must have a clear understanding of the threats, challenges, and opportunities we face. That requires information. Now, there is no shortage of information in Washington, but there is a severe shortage of information that is comprehensive, accurate and unbiased. What we have in abundance are "facts" tainted by the bias and manipulation of moneyed interests, intellectual crusaders, and the special pleading of bureaucrats defending programs that benefit particular agencies.

As an important part of its activities, Liberty Lobby alerts the public to efforts by special interests to distort and manipulate information reaching the Congress. Likewise, we call attention to those organizations and individuals that are providing Congress with facts and insights that can be trusted.

The Office of Technology Assessment (OTA) is such an organization. OTA is staffed by experts from the sciences and engineering with access to the top scientific talent in the country. The Liberty Lobby has carefully observed OTA's output over many months. I am happy to report that this is one government agency that has a record of facing up to the tough issues and letting the chips fall where they may without shaving the evidence or distorting the findings to favor some prior interest-or preconception. It does this with less that 1% of the Congressional budget making it the taxpayer's best bargain.

Congress must know where technology is taking us—the problems it raises and the solutions it offers. Take, for example, the issue of how the burning of fossil fuels is affecting the atmosphere through the buildup of carbon dioxide and oxides of sulphur and nitrogen. The apparent consequences are acid rain on the one hand and a heating of the earth's atmosphere with a consequent rise of ocean levels (as the Arctic ice melts) on the other. How bad is the problem? What can be done? The public policy implications are staggering. Or take synthetic fuels. How much can be produced, at what cost, from what sources, with what consequences? How much public money will be required? What are the alternatives? If the Congress is to face up to issues of this gravity and respond effectively, it must have clear knowledge what it is up against. This is why OTA is so badly needed. Science and technology are of immense importance to our collective future. Citizens need the assurance that Congress is receiving a true picture of what the future can be.

Sincerely,

ROBERT M. BARTELL,
Chairman, Board of Policy.

NEW YORK STATE ENERGY RESEARCH
AND DEVELOPMENT AUTHORITY,
February 16, 1982.

Hon. CHARLES McC. MATHIAS, Jr.,
Chairman, Committee on Rules and Administration, U.S. Senate, Russell Senate Office Building, Washington, D.C.

DEAR MR. CHAIRMAN: I offer the following brief personal statement for the record for your February 5, 1982, oversight hearing on the Office of Technology Assessment.

OTA has served the Congress and the nation well; and I wish to express my strong support as you review its record since it was established in 1972.

OTA was created in response to the widespread recognition that the Congress needed its own source of expert advice on science and technology-related problems and issues. Nothing had changed since 1972 to lessen that need.

I have observed OTA closely since 1972 and the record is clear. OTA has done an outstanding job in providing the Congress information it needs for dealing with science and technology problems and issues in several areas. In energy, the area of its work I know best, it has produced, among others, well-informed, highly respected reports on biomass, oil shale, coal slurry pipeline and the direct use of coal. The OTA critiques of the 1975 ERDA Plan and Program, 1975 ERDA Budget and the National Energy Plan were available to the Congress and the public when critical decisions were being made as to the role and responsibilities of the Federal Government in energy.

What is amazing about OTA is that it has produced its many high-quality products on a very small budget and with a very lean professional staff. But its smallness and its focus on science and technology and the future are key attributes of its uniqueness. It is because it is so highly respected that OTA is able to get the nation's most highly qualified experts to serve as consultants and on study panels. Over its lifetime, OTA has developed an extensive national network of public and private sector experts, many of whom it calls on each year.

OTA panels are interdisciplinary. Panel members bring a wide range of expertise and a variety of perspectives to bear on the problems and issues being analyzed. This approach is both an essential element in technology asessment and in ensuring that the Congress obtains the kind of interdisciplinary, balanced products it needs in dealing with complex science and technology problems and issues. Among the Congressional service agencies, this approach is unique to OTA.

In summary, OTA is an institutional innovation that has paid off. It complements, rather than competes with, other Congressional service organizations. Among the Congressional Service Agencies, OTA is unique in its focus on science and technology problems and issues, and the future, and in its approach. It has done an outstanding job in providing the Congress well-informed, inter-disciplinary analyses, drawing on the nation's best talents, including its own small, but exceptionally competent, staff.

The Congress need for its own source of expert advice on science and technology-related problems and issues has, if it has changed, increased since 1972. I am confident that your oversight hearings will lead you to conclude that OTA deserves your continued strong support.

Sincerely,

IRVIN L. WHITE, *President.*

ATLANTIC RICHFIELD CO.,
Los Angeles, Calif., March 3, 1982.

Senator CHARLES McC. MATHIAS, Jr.,
Chairman, Senate Committee on Rules and Administration,
Washington, D.C.

DEAR SENATOR MATHIAS: I am writing to respond to your invitation to submit testimony in connection with the Office of Technology Assessment. To my profound regret, your invitation arrived at a time when I was away on business and have just returned from West Berlin so I was unable to provide the strongly supportive testimony commenting on the high importance and extreme usefulness with which I regard the work of the Office of Technology Assessment, and the great skill and competence of its Director, Dr. John H. Gibbons.

Sincerely yours,

D. STERNLIGHT.

UNIVERSITY OF CALIFORNIA, BERKELEY,
SCHOOL OF PUBLIC HEALTH,

Hon. CHARLES McC. MATHIAS, Jr.,
Chairman, Senate Committee on Rules and Administration, U.S. Senate, Russell Senate Office Building, Washington, D.C.

DEAR SENATOR MATHIAS: I am pleased to learn that you are holding hearings concerning the role of the Office of Technology Assessment and would like to share my perspective with you. My contact and involvement with the Office have extended over a number of years and in a variety of roles. In 1976, when I was State Health Officer of Illinois, I drew heavily upon one of the earliest reports issued by the OTA, namely, "Drugs Bioequivalence". At that time we were working for the passage of a generic drug law, and the material in the OTA report provided us with the best scientific data available concerning the bioequvalency of generic drugs. The report provided important material which aided us in developing our legislation and in testifying before the state legislature.

In 1977, when I was Deputy Assistant Secretary for Health-Programs in HEW, I was involved in the development of that Department's position on assessment of health care technology. Here, again, two OTA reports were important in laying out the issues and presenting options for dealing with the increasingly complex problems of development diffusion, and use of medical technology. The two reports—"Opportunities for Medical Technology Assessment" and "Assessing Safety and Efficacy"—had a major impact on the final form of the legislation establishing the National Center for Health Care Technology.

With this prior knowledge of the activities of the OTA, I was pleased to join the staff in 1978 as Assistant Director, responsible for the Division of Health and Life Sciences. In that role I was involved in the development of sixteen reports covering a wide range of areas including population, genetics, agriculture, and renewable resources, as well as health. I found the internal staff to be insightful, well motivated, and of the highest calibre. I found the OTA process for report development and review to be an exceptionally fine one. The advisory committees assembled to aid in the design and review for each study were composed of outstanding experts from a broad set of disciplies. The willingness of such people to serve, in itself, is testimony to their view of the importance and quality of the OTA work. Further, the review process was exceptional in its breadth and thoroughness. I believe the OTA process assures Congress of up-to-date and scientifically sound reports and well thought out analyses and options. I believe all of the OTA reports have made a contribution to the development of government policy. It is beyond the scope of this letter to recount the impact of all of the reports I was involved in, but I can cite just a few.

The major study of the health group on cost-effectiveness analysis with its accompanying case studies, including those on pneumoccal and influenza vaccine, have clearly been of influence at both the state and federal levels. The study on the impacts of applied genetics has been well recognized as the most comprehensive document to date and will continue to be of importance as Congress addresses these issues. The study on the structure of the agricultural research system has already been influential in making policy in this regard in both the executive and congressional branches of government.

Needless to say, I found my three years at the OTA to be exceedingly worthwhile. They enabled me to broaden my knowledge and grow professionally, as well as giving me the opportunity of contributing to the development of national policy.

In my new role as Dean of the School of Public Health at Berkeley, I know I will draw heavily on the work of the OTA, both in my teaching and in my consultative role to the State of California.

In conclusion, then, I believe the OTA is an important resource for the Congress, that it has earned a excellent reputation for scientific work, and that it deserves the continuing support of the Congress.

Sincerely,

JOYCE C. LASHOF, M.D., *Dean*.

PREPARED STATEMENT OF DR. JOHN L. McCORMICK

The Environmental Policy Center specializes in energy, environmental and natural resource policy and, as a consequence, deals regularly with technological issues. We have found that the Congressional Office of Technology Assessment (OTA) has become a valuable resource for Congress. OTA has an almost unique ability to synthesize vastly complex scientific fact and technical data into clear focus for policy makers. OTA provides reliable information on the role of technology in a broad array of current, crucial issues, a prodigious job, but one performed well—not only do the important questions get asked, but they get answered to the extent our national expertise allows. And OTA provides a benchmark for objectivity as well as a storehouse of knowledge, values that will serve Congress well as research programs are reduced and/or dismantled in the Administration.

RELEVANCE

The resource issues on which we at EPC focus include those critically affecting the environment, economic growth, and national security. These include energy conservation, water conservation, coal mining, nuclear waste disposal, radiation health effects, subsidies to energy production, synthetic fuels production, clean air, oil imports, mineral production on public lands, transportation, and agricultural lands. OTA has produced many fine reports on these subjects, including: "Residential Energy Conservation"; "Energy From Biological Processes"; "Gasohol"; "Conservation and Solar Energy Programs of the Department of Energy—A Critique"; "Onsite Solar Energy"; "Enhanced Oil Recovery Potential In the United States"; "Gas Potential From Devonian Shales of the Appalachian Basin"; "MX Missile Basing"; "Technology and East/West Trade"; "An Assessment of Development and Production Potential of Federal Coal Leases"; "Effects of Nuclear War"; and "Technology and Steel Industry Competitiveness"; to name only a few.

We have used the above reports and many others from OTA internally to develop policy positions based on fact and logic. We frequently recommend them to Congress for background. And we refer members to the authors of these reports—OTA inhouse experts—for additional, up-to-the-minute information.

RELIABILITY

We have always found OTA published reports to be technically superb. We have confidence in the arduous process through which OTA produces reports. Their method of using acknowledged experts to supplement staff capabilities provides access to the best talent on our nation's technical community. More importantly, the review process, and especially the existence of inclusive advisory panels of representing diverse interest, assures objectivity. We at EPA have participated in a number of these panels and are impressed by OTA's willingness to respond to criticism of draft documents to assure correctness in the final product.

USEFULNESS AND IMPACT

OTA's reports have in the last couple of years become timely. The report "MX Missile Basing" is an excellent example of OTA providing Congress a thorough, reliable study at a crucial point in a debate of immense interest and consequence. Another example is a recent report on the leasing of public lands, now a topic of intense debate. Still another, is "Soviet Energy Availability", which interests us because of our work on U.S. oil imports and national security. The importance of this report to Congress is obvious as the U.S. and its allies debate possible sanctions against the U.S.S.R. in response to the Polish crisis, particularly the embargo of equipment for the Soviet national gas pipeline to Western Europe.

Studies underway promise to be of substantial interest to Congress. Natural gas availability, cogeneration, industrial energy use, oil supply disruption—these are topics of continuing and vital interest to U.S. citizens and the representatives.

We have found, too, that OTA studies have a great deal of staying power. "Residential Energy Conservation", "Prospects for Enhanced Oil Recovery", "The Effects of Nuclear War", these are studies we still use and still recommend to Congress and the Press and find that members use their benefit.

SUMMARY

We have found OTA a valuable technical resource. OTA reports are not only technically superb, but accessible. The Office is a resource that undoubtedly has saved many times its cost by providing timely information to decision makers. In this era of austerity, it is more important than ever that we be efficient in our allocation of resources. A small investment in reliable information—in OTA—will pay off in the near term and for decades. OTA will be critically important now that it appears that information from Administrative agencies will be less available due to budget cuts and other constraints.

SCIENTISTS' INSTITUTE FOR PUBLIC INFORMATION,
New York, N.Y., February 9, 1982.

Hon. CHARLES MC. MATHIAS, Jr.,
Chairman, Senate Committee on Rules and Administration,
U.S. Senate, Washington, D.C.

DEAR SENATOR MC. MATHIAS: I would like to enter into the record of the oversight hearings on the Office of Technology Assessment some brief comments.

The Scientists' Institute for Public Information enjoys a close and productive relationship with OTA. First, we often use their reports and analyses as resource material, as well as springboards into issues we think warrant further study. Second, OTA staff often use our material and resources as springboards into further studies they might do. In this regard, our resource base of scientists and engineers is often useful to them as they develop a study.

Third, and perhaps most important, the studies and resource people on OTA advisory committees are very important in our ongoing relations with the media in SIPI's Media Resource Service. They make sure that we are aware of a study's release, so that we can prepare for the calls the service gets (MRS is a referral service for the press, which identifies relevant qualified personnel for the press when they call). Also, we often use the work of OTA as a basis for our series of media roundtables—off-the-record, background briefings on specific issues between leading members of the scientific community and the press.

We judge the work of OTA to be of the highest caliber and relevance. Indeed, we think so highly of it that we think more should be done in the area of press relations. It is distressing to us that many of the press we talk to are not aware of the high caliber of work done, the relevance of the studies, and the importance of such an activity. More work should be done in this regard.

If we can be of any further help in this matter, please let us know.

Sincerely,

ALAN MCGOWAN.

PREPARED STATEMENT OF DR. HARVEY BROOKS

Mr. Chairman, I would like to begin by saying that I have followed the evolution of OTA from its beginnings, having worked closely with Congressman Daddario and his staff in defining the concept and political role of technology assessment, and in formulating the Technology Assessment Act of 1972. I chaired the panel of the National Academy of Sciences which prepared the report, Technology Processes of Assessment and Choice, which was published by the Committee on Science and Astronautics of the House in July 1969. In the spring of 1971 I introduced a course on technology assessment at Harvard, designed as a general interest course for Harvard undergraduates from a wide variety of backgrounds, both technical and nontechnical. I am still giving this course, which has become quite popular, and the necessity of keeping it up to date has forced me to follow developments in the field and to keep fairly close track of the activities and output of OTA. I believe that during the last two years, under the leadership of Jack Gibbons, OTA has begun to realize the potential that our panel had envisioned for it in 1969.

OTA is not the only institution in the Congress that deals with technology assessment. The General Accounting Office, the Congressional Research Service, the Congressional Budget Office, and many individual committees of both houses are engaged in technology assessments in at least part of their work. Nevertheless, I feel that OTA performs a distinctive function in this area which is not, and probably cannot be, carried out by any other institution. To support this proposition I would like to go through a catalogue of issues and problems related to OTA in order to bring out its special role. In analyzing these issues I hope I will bring out, directly or indirectly, the answers to the three questions raised by the Chairman. They are all issues which must be continually kept in mind in determining the agenda of the Office, and in assuring both the professional quality and the political relevance of its work products.

1. BALANCE BETWEEN RESPONSIVENESS TO CURRENT CONGRESSIONAL CONCERNS AND RELEVANCE TO LONGER TERM NATIONAL AND INTERNATIONAL PROBLEMS AND NEEDS

No issue has been more difficult to resolve in the history of OTA than this one. In its early years OTA, perhaps properly and inevitably, placed what seems in retrospect to be excessive emphasis on soliciting problems and issues from Congressional committees, and undertook too many studies of narrow scope and transitory significance, even though many such studies were quite useful in the immediate context in which they were undertaken. Probably what was seen by much of the professional community as over-responsiveness to the Congress was a necessary first step towards establishing credibility and insuring a base of political and financial support.

In the next phase there was something of an over-reaction in the other direction. An effort was made to draw too sharp a distinction between short term and long term studies, resulting on the one hand in inattention to the long term implications of short term issues and on the other in overly ambitious and comprehensive undertakings, such as the studies on the "health of science." I believe that during this period Congress got a sense, rightly or wrongly, that OTA was setting off too much on its own, and was running the risk of losing touch with the day-to-day issues pressing upon the Congressional committees. Some of this may have been simply lack of communication, combined with the relative newness of OTA, and the rapid turnover in Congress and Congressional staff which was taking place at this time.

I believe that OTA now appears to be moving towards a happy balance between responsiveness to Congressional concerns and longer term interests.

This is appropriate as OTA becomes better established in the eyes of Congress. It appears to have improved its communications with the Congress while at the same time gaining more attention and respect in the outside professional community. It is thus providing a new bridge or translation device between a wide base of professional expertise in the country and the exigencies of political decisionmaking. The growth of calls on OTA staff to testify on current issues provides one evidence of the relevance of its studies to Congress, while the growth of sales of its reports, their republication by commercial publishers, and the use of many reports in university courses provide evidence that they are dealing with issues judged important by an expert audience, both national and international.

The organizational memory developed by a strong permanent staff also provides a means for continuously monitoring Congressional interests as well as current technical developments so as to be responsive to both on a continuing and cumulative basis.

2. MAXIMIZING OBJECTIVITY AND MINIMIZING BIAS ARISING FROM SPECIAL INTERESTS

Complete objectivity is an impossible ideal, especially when the issues dealt with are already the target of strong vested interests and political feelings. The issues that come before Congress are almost certain to be those in which scientific uncertainties and incomplete data leave considerable scope for political predilections and implicit assumptions to influence conclusions. The best that OTA can hope to do is to see that those matters on which there is a reasonable degree of consensus in the relevant expert communities are clearly brought out, and that those matters which are still largely judgmental are presented in such a way as to fairly represent the full range of responsible professional judgments, with neither exaggeration nor understating of uncertainties.

Given the controversial nature of many of OTA's studies, it is really remarkable that there have been so few accusations of bias or unbalanced presentation. Of course, such balance can sometimes be frustrating to busy politicians looking for clearcut answers, as indicated by the old saw about two-handed scientists, but I think Congress properly looks to OTA to reflect the state of the world as it is, not as a decision-maker might like it to be. The use of extensive external reviews of reports, and the effort to have an advisory committee for each project which represents a wide range of viewpoints on an issue increases the time required for studies, and makes them more difficult to complete, but keeping the final responsibility for the report firmly in the hands of OTA staff prevents special interests or parochial viewpoints from exercising excessive influence.

3. SELECTIVITY

The OTA carries our far fewer studies than it receives requests for from Congress. Thus it faces a constant problem of setting priorities. In my opinion it is a good thing that OTA is relatively small, and that this forces it into hard choices in what it undertakes. The process of making these choices is itself informative to the Congress, and contributes to the successful balancing of shorter term and longer term problems on the agenda. It is fortunate that growing success and acceptance is not tempting OTA to expand too fast. The very smallness of its staff, and the extensive use of external input helps to create an effective internal communications system which insures against over-specialization, and the replacement of overall priority setting by parochial professional or political hobbies as the primary determinants of its agenda.

4. EXTERNAL INVOLVEMENT

OTA is probably unique among Congressional agencies in the degree of its outreach to the whole professional community in the United States, and even to some extent abroad. It is not that Congress as a whole does not make extensive use of external inputs through testimony, and through its excellent information retrieval systems via the Library of Congress and other sources. But I feel that OTA has been more systematic in canvassing both the national professional community and the Congress and Executive Agencies to identify upcoming problems and issues. Each OTA study uses an advisory panel representing not only a broad spectrum of professional views but also the interests of potentially affected publics. Draft reports are subject to extensive outside reviews, and on some controversial studies outside critiques are published with the OTA report. The OTA also uses workshops and informal public meetings to gather further inputs.

5. OUTREACH

The reports of OTA appear to be very popular with the public, and have sold more widely than most government publications. Furthermore, since 1980 the rate of increase of sales of OTA publications has accelerated by a factor of nearly four. OTA reports are increasingly used in college courses, and there has been created an OTA fellowship program that brings up to six midcareer professionals or recent graduates from graduate schools to work for a year in the office. The OTA staff conduct frequent special briefings for Congressional committees. This outreach effort is, of course, of direct benefit to OTA itself in getting it better known to a wide constituency, but more importantly wide dissemination of its studies serves as an important instrument for educating the attentive publics on the issues dealt with by OTA. The benefits of this public education will become evident only gradually, but will be cumulative so that public debate on many complex issues should gradually be raised in level.

6. COOPERATION WITH OTHER AGENCIES

Coordination between OTA and three other Congressional agencies which carry out studies potentially overlapping with OTA have greatly improved. The four agencies, OTA, CRS, CBO, and GAO are increasingly complementary in their efforts and draw on each other's work. The computerized Research Notification System operated jointly by the four agencies keeps each aware of ongoing or recently completed studies, and this formal procedure is supplemented by frequent meetings of senior staff. The outreach program of OTA, its extensive use of outside consultants and reviewers, and its prompt notification of the entire Congress of ongoing and completed studies also serve to improve coordination of its work with the other agencies. The Director has given a number of examples in which OTA has been able to draw on data developed by one of the other agencies.

7. RESTRAINT OF GROWTH

So far OTA seems to have avoided the temptation to build too fast upon its success and acceptance. Its professional staff is the smallest of the four Congressional agencies, and its small size forces a discipline of selectivity which is in itself valuable, in that the very process of selecting the most important issues provides important signals to the Congress, quite apart from the substantive work done on those issues. Above all, however, small size is important to retaining good internal communication and avoiding overspecialization within the staff. Reliance on outside consultants and contractors for nearly fifty percent of its efforts has the virtue of forcing the staff to cover wider territory and preventing it from becoming too preoccupied with specific areas of specialization, thus distorting policy priorities by parochial professional priorities. Its smallness helps it to avoid the trap pointed out by Laski of developing an expertise that "sacrifices the insight of common sense to intensity of experience" and makes its results "the centre of relevance to which all other results must be related." In other words OTA's particular size and mode of operation seems well configured to compel its staff to retain a "generalist" perspective which is essential to its effective interaction with political decision making.

I would now like to say a few words about suggestions for future OTA activity. Up to the present time these suggestions would have probably been unrealistic while OTA was establishing its credibility and competence, but I think it is now in a position to somewhat extend the scope of its work. I have three specific suggestions:

1. One of the functions for an OTA envisioned in the 1969 NAS report was that of a kind of "assessor of assessors." The specific functions envisioned are described in items 3 and 4, p. 91-92 of that report. Item 3 states "Review specific assessments performed by other government agencies or departments, either on its own initiative or by request from other agencies, from selected persons elsewhere in government, or from responsible spokesmen of various private interests. Such review would be confined to an evaluation of (a) the criteria and procedures employed in the assessment process, (b) the nature and technical adequacy of the evidence relied upon, and (c) the representation of potentially affected interests."

I feel it would be highly desirable for OTA to carry out selectively and publish critical reviews of major technology assessments carried out elsewhere in the government or, even occasionally, under private auspices, for example, the Global 2000 report, or the CONAES report of the NAS.

2. It would be desirable for OTA to have more interaction with studies in the area of science policy. For example, it might carry out a review and critique of the Five Year Outlook Report of the National Science Foundation or of the Science Indicators series. It should also make a greater effort to evaluate the implications for national R. and D. priorities of some of its assessments. In fact a serious weakness of technology assessment as it is now carried out lies in the comparative lack of feedback to overall science policy of the individual assessments that are carried out in many places in government.

3. It would be desirable for OTA to move cautiously towards attempting more studies of the possible long term social impacts of new technologies and possible strategies for managing them. This is a difficult area because it is much more speculative and controversial than the study of environmental impacts or economic impacts. Some of the studies on industrial competitiveness represent a first step in this direction, but I feel that OTA should search out more opportunities to study specific social consequences such as effects on employment, the configuration of cities, the further growth or assimilation of an "underclass," etc. Studies of the impact of computer technology and office automation on the quality of working life might be one area of interest.

PREPARED STATEMENT OF J. FRED BUCY, PRESIDENT, TEXAS INSTRUMENTS INC.

It is indeed my pleasure to provide testimony to the first oversight hearings by the Senate on the Office of Technology Assessment (OTA). My remarks reflect my service as a member of the Technology Assessment Advisory Council (TAAC) from its inception in 1974 until the expiration of my term on the Council in July, 1981. They also reflect my perspective as President of a high techology corporation, where we are highly sensitive to issues of productivity and cost effectiveness in evaluating organizational performance. From both perspectives, I conclude that OTA has evolved from its initial growing pains and frustrations to an increasingly mature and valuable source to be used by all congressional committees and the public at large.

When OTA was established in 1974, it was unclear how the organization would evolve. During this formative period, OTA was struggling with the fundamentals: how to do a technology assessment; how to properly staff a program; how to respond to congressional requests for assessments; and how OTA staff, the Technology Assessment Board (TAB) and TAAC should relate to one another. Quite honestly, I was concerned during this period that OTA would be unduly influenced by antitechnology forces, i.e. by those emphasizing only the negative potential of technological innovations.

Of particular concern to me during this early period was the relationship of TAAC to the TAB and OTA staff. There was tremendous uncertainty as to what exactly TAAC should do or how it should interact with the other elements of OTA. During much of the early period, the TAAC was too unfocused and decoupled from strategic issues such as program selection and direction, and spent too much of its time advocating particular points of view and reviewing drafts of reports already in preparation.

Now I believe that, after its early growing pains, OTA is steadily evolving into a solid, respected organization capable for quality and balanced analysis. Dr. Jack Gibbons, current OTA Director, deserves much of the credit for the recent progress. He is a competent technologist with balanced views on the issues at hand. Further, he has managed to interface effectively with both the TAB and TAAC. With respect to the TAAC, he has listened to its guidance, but also has controlled the group as a constructive force, rather than permitting the TAAC to function as individual single-issue advocates.

In order to keep OTA moving in the direction of increasing respect as a unique analytic resource for the Congress, it is essential that the TAB, the TAAC and the OTA Director continue to monitor certain key indicators, and take action when "warning signals" appear.

1. First, the backlog of work should be carefully monitored to ensure a timely conclusion to studies. Dr. Gibbons has done a good job of eliminating the backlog of old projects, and the existing portfolio of studies is generally on a 10-to-20 month track to completion. This must be continued in the future.

2. Second, the subject matter and conclusions of the proposed, ongoing, and completed assessments should be examined to ensure that no special interest group has captured undue influence. Study conclusions should be periodically reviewed to ensure a balanced treatment, e.g., no systematic bias in favor of government solutions, no systematic winner in the environmental vs. economic growth tradeoff. OTA simply cannot survive if it becomes an advocate of a particular political point of view in a pluralistic Congress. I believe the growing credibility of OTA with the Congress and general public attests to the progress made in this area.

3. Third, the basic approach to technology assessment should not presume technology is a negative or at best neutral force which must be applied in a "zero risk" fashion. Rather, a more positive definition of technology should be embodied which stresses its fruitful application to our most pressing national problems. Dr. Gibbons has done a good job of introducing a more positive approach to technology assessment.

4. Fourth, the TAAC function should be diverse, balanced and well tied in to both the TAB and OTA staff. I believe that reducing the number of TAAC meetings and encouraging individual TAAC members to serve on advisory committees in particular studies or program areas are important steps. In order to strengthen TAAC, members should be selected with the same attention to geographical and political balance as that given to TAB. The best way for this to be accomplished may be for each board member to appoint a council member. It would also be fruitful to add the Director of the Congressional Budget Office (CBO) as a statutory member of the TAAC.

5. Fifth, it is essential that OTA maintain a unique identity and mission. Its uniqueness comes from (1) its focus on science and technology, and their consequences for innovation and change; (2) the high level of technical expertise brought to bear on studies; (3) its medium to long-term focus; and (4) the integration across a wide range of disciplines and dimensions of an issue in the conduct of analysis. To preserve its uniqueness, OTA should not be overloaded with studies that could be performed by General Accounting Office (GAO), Congressional Research Service (CRS), or CBO. Since the OTA agenda is set primarily by the questions put to it by congressional committees, pressures will always exist to conduct quick turn-around studies of short-term issues. I am fully supportive of OTA providing interim products that draw on existing longer-term analyses. However, there is a danger that OTA resources may be consumed by requests to undertake short-term studies unrelated to ongoing assessments. Unless short-term study requests draw on existing longer-term assessments, they should be conducted by CRS, GAO or CBO, and not by OTA. Keeping OTA unique will require discipline on the part of committees not to ask OTA for short-term studies better performed by other agencies, as well as cooperation among the congressional agencies, minimizing competition and moving studies to the most appropriate location. My impression is that progress has been made in recent years, but this issue must be closely monitored in the future.

6. Finally, OTA can ensure its continued vitality by keeping overall staff size small; by relying heavily on high-quality, experienced outside consultants; and by keeping the rotation rate for OTA analytic staff high.

In summary, OTA consumes a very small part of the congressional budget, for which Congress is getting a great deal of reliable, technically proficient analysis. I have greatly enjoyed the seven years I have been associated with the OTA, and I have great confidence that the progress made over the past several years will continue with even greater contributions in the future.

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